JUDGING
Dairy Products

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and
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3rd EDITION

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JUDGING DAIRY PRODUCTS

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To

THE DAIRY INDUSTRY

for

The Advancement of the Program

in

The Judging and Grading of Dairy Products

This Book is Dedicated

PREFACE AND ACKNOWLEDGMENT TO THE FIRST EDITION

This book is intended for those who desire definite knowledge concerning the fundamentals of judging dairy products. The material presented has been gathered from many different sources and much of it was gained by the authors in dairy products judging contests and also in coaching dairy products judging teams. For the advanced student or one who has had experience in sampling or scoring dairy products much of the detailed information may be omitted. For the beginner it contains many details which he must master before he can become proficient in the art of judging. After the fundamentals of judging are mastered, more experience is usually required before the student can qualify as a judge. If the experience, secured by judging in contests or judging commercial dairy products, is properly correlated with the essential fundamentals in this text, the student should soon become proficient in the judging and the grading of commercial dairy products.

The authors wish to express their grateful appreciation to the following individuals for their constructive criticisms and assistance in the preparation of the manuscript for this book:

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York State Agricultural Experiment Station, for their constructive criticisms of the chapter on Judging Ice Cream.

They are also greatly indebted to other individuals and organizations who so willingly supplied illustrations and other material for the book.

PREFACE TO THE SECOND EDITION

The First Edition of Judging Dairy Products was published in 1934. It was intended primarily for those who desired definite knowledge concerning the fundamentals of judging dairy products. Due primarily to the lack of established judging and grading standards, information concerning only the judging of market milk, butter, cheddar cheese and vanilla ice cream was included. In order to make available in one volume similar information on other dairy products for which standards have been adopted, either definitely or tentatively, discussion of desirable and undesirable qualities as well as judging and grading information on these products have been included in the Second Edition. The inclusion of this material, with new knowledge on the scoring and grading, have necessitated the complete rewriting of the entire book.

Since the publication of the First Edition, much interest has been displayed in the judging and grading of all dairy products. For example, milk and cream are graded more carefully for manufacturing purposes today than was done in the past; the amount of butter and cheese graded at terminal markets has increased; some co-operative federal and state butter grading programs have been established; while in some states laws have been passed pertaining to consumer grades on butter. Likewise, consumers are becoming more interested in the evaluation of qualities and grades of dairy products. Recognizing that good flavors in dairy products make for greater consumer appeal, and that undesirable flavors have the opposite effect, dairy plant managers are more conscious of flavor in dairy products today than ever before. Consequently, the demand for detailed information concerning the scoring, grading and judging of all dairy products has made necessary a wider coverage of the subject than was possible in the First Edition.

This book is intended not only for the classroom or the laboratory of the dairy products' instructor, but for research and extension workers in the dairy industry field as well. It is hoped that the dairy products grader will find the information useful and that the dairy plant operator or plant worker will find the volume a good guide either in the grading of raw materials to be made into finished products or in the selection of manu-

factured products. Furthermore, it is considered that the consumer will find the quality descriptions and illustrations useful as a guide in purchasing the grade of dairy products desired.

The authors wish to express their gratitude to the many investigators whose studies have been freely cited in the text. Special appreciation is felt toward the committee on Judging Dairy Products, American Dairy Science Association, as well as the various coaches of dairy products' judging teams and dairy products judges, and students, whose contacts, experiences, interests and suggestions have been a stimulus to incorporate in one volume more complete information on dairy products judging. The helpful criticisms of Professor J. M. Jensen, Professor P. S. Lucas, Dr. Earl Weaver and Dr. I. A. Gould in respect to certain phases of the text are gratefully acknowledged. The generosity of the Michigan and Montana Agricultural Experiment Stations and other organizations for use of illustrations is appreciated.

March, 1948.

John A. Nelson

G. Malcolm Trout

PREFACE TO THE THIRD EDITION

The generous acceptance of the second edition of Judging Dairy Products, exhausting the issue, has made imperative the printing of the third edition. All acknowledgments pertaining to the previous editions, as well as general comments, are repeated again in this edition. The data have been carefully checked to bring the third edition as close as possible to final date of printing. Particularly, is this applicable to the appendix material, much of which has been substituted and revised to aid in the usefulness and timeliness of this book.

March, 1951.

John A. Nelson

G. Malcolm Trout

Table of Contents

List of Tables

List of Illustrations

Page

CHAPTER I

INTRODUCTION

Development of Dairy Products Judging and Grading

Inasmuch as the senses of smell and taste have always been used by man to guide him in the selection of food, the discrimination between desirable and undesirable foods is apparently as old as man. The selection of dairy products with a good flavor, particularly milk, butter and the various kinds of cheese, dates back to the early use of these products. Early American agricultural writers, apparently recognizing that the consumption of dairy products as human food depended primarily upon their taste, cautioned the dairyman concerning certain feeding and milk handling practices if a quality dairy product were to be obtained. For example, Deane[1] advised: "In feeding milch cows, the flavour of the milk should be attended to, * * *. Feeding them with turnips is said to give an ill taste to the butter made of the milk," and also concerning the salting of butter, "An ounce and a half, or more of the strongest and best salt, very finely powdered, should be worked into a pound of butter, and so thoroughly mixed that every part may be equally salted. For if ever so small a part misses of being salted it will turn rank and communicate its ill taste to the remainder."

Role of Exhibits and Contests

The displays and exhibits of butter and cheese at fairs, shows and agricultural society meetings played a very important role in the development of a consciousness of the quality of dairy products. However, not until the latter part of the 19th century did the grading of dairy products assume national and international attention. The establishment of grades, with the attendant scoring and grading score cards, and standards for the various dairy products parallels quite closely the growth of the dairy industry and the development of the dairy products markets. Although the dairy industry departments of the agricultural colleges early emphasized and taught the merits of quality in dairy products, it was not until 1916 that the first

Students' National Contest in the Judging of Dairy Products was held.[4] At that time only butter was judged. The following year the judging of cheese and milk was introduced into the contest. Vanilla ice cream was first used in collegiate student judging in 1926.

The Students' National Contest in the Judging of Dairy Products has been held annually from 1916, with the exception of 1918 and 1942 to 1946, inclusive, due to World War I and II, respectively. As many as twenty-three teams of three men each have participated in the national contest at one time. To appreciate fully how effective this program has been in furnishing the dairy industry with trained men, one must consider the number of contests, National, Eastern, Western and Southern, that have been held throughout the years and the number of men who have taken part in them, not only as members of a collegiate team, but as alternates and college students who "tried out" but never "made" the team. These men entered the industry well trained in the knowledge of what constitutes quality in dairy products.

Food research has played an important role in the development of the dairy industry. During the past two decades, par-

(Courtesy Ohio Salt Company)

Figure 1 — Scores and Grades of Dairy Products Are Established Through Organoleptic Examination.

ticular attention has been focused on the palatability of dairy products (Figure 1) to the extent that much research has been directed toward the improvement and stability of flavors of dairy products. This has given a real impetus to the judging and grading of dairy products. The growth of the judging and grading of dairy products has extended over many years with the greatest development during the past score of years.

Establishment of Brands and Trade-Marks

The beginning of the 20th century witnessed the establishment of brands and trade names for dairy products, particularly butter and cheese. This movement necessitated the recognition of standards of quality by the manufacturer and the grading of the finished product by an experienced judge. Some of the brands thus established have become widely known. For example, the Lür mark for high quality Danish butter, instituted in 1906 has become perhaps the most famous trade-mark of ex-

Figure 2 — The Iowa Trade-mark for Quality Butter.

port butter.[2] The Iowa trade-mark for butter (Figure 2), adopted in 1915,[3] is based upon quality factors of the product and upon sanitary conditions and manufacturing methods within the plant. This trade-mark is the cornerstone upon which the Iowa State Brand Creameries, Mason City, Iowa, operate, through which nearly 25,000,000 pounds of butter were marketed in

1941.[2] Likewise, the Land O' Lakes Creameries, Incorporated, of Minneapolis, Minnesota, have established the Land O' Lakes Brand which is also based upon a quality product. More recently, Sealtest, Incorporated, New York City, a subsidiary of the National Dairy Products Corporation, has established the Sealtest Brand for high quality products, primarily ice cream and milk. Many sectional and local dairy establishments have their individual brands which the public recognizes as certain standards of quality.

The Importance of Judging and Grading Dairy Products

Dairy products can be analyzed for chemical composition, microorganisms, vitamin content, enzymatic activity, color and physical properties, but these determinations do not measure the "eating quality" of the product. Two samples of butter may have identical chemical composition, color, firmness and spreadability, however, one sample may be greatly relished by the consumer, while the other makes a very poor impression. The sample that is liked by the consumer has good "eating quality." It has a clean, creamy, aromatic flavor and is fresh and appetizing, while the sample that made the poor impression may be stale, rancid, fishy or have some other objectionable flavor.

The "eating quality" of a dairy product includes all those sensations such as feel, taste, and smell which the consumer experiences when the product is taken into the mouth. Although the essentials that go to make up the "eating quality" of dairy products cannot be measured by ordinary chemical and physical means, they can be determined organoleptically to a high degree of accuracy by competent judges. Thus, tasting and smelling are fundamental in the judging and grading of dairy products.

Due to increased consumer interest, to the interest of processors who desire to sell their products on grade, and to the purchase of dairy products by the federal government, the judging and grading of dairy products has made very definite progress in the past decade. The sales of graded dairy products are increasing yearly. Consequently, everyone engaged in the production, manufacture, sale, and purchase of dairy products is becoming more interested in how the grades of these products are established. Particularly are consumers becoming grade conscious.

Knowledge of Standards Valuable

Milk and cream producers, who are co-partners with dairy products manufacturers in establishing flavors, desirable or undesirable, in the resulting manufactured products, should recognize that dairy products cannot be of higher quality than the raw material from which they are made. Without definite knowledge as to what constitutes desirable and undesirable flavors, any progress in the production of high quality raw material is difficult. Unfortunately, milk and cream flavors receive too little attention from most producers. If dairymen had a better understanding of the flavor demands in the market, a knowledge of the relative importance of the various flavors and specific information concerning the methods of obtaining desirable flavors and the elimination of undesirable ones, they would be in a better position to produce milk and cream that would make high scoring finished products.

Every enterprising processor of dairy products has a desire to make a good product. Ability to discriminate against certain objectionable flavors and manufacturing defects and to recognize desirable flavors and makeup characteristics will enable the processor to make a product of good consumer acceptance. A manufacturer who sells dairy products on the wholesale market should know the various grades of the products. He should be familiar with the flavors and workmanship that make up the various grades. The manager who understands market demands and who has the ability to select consistently the grade desired by certain markets will discover that his products, because of uniformity, meet with ready sale. In case of shortage of his own make, the dairy plant manager must occasionally purchase dairy products on the open market or from nearby plants to be sold as his own product. In such instances the ability to detect definite undesirable flavors is indispensable. The purchase of a product of inferior quality to be sold as a substitute for a well advertised brand would result in driving the established brand off the market.

The consumer is interested in obtaining knowledge which will enable him to buy dairy products more intelligently. A knowledge of the defects in the manufactured products, the desirable and undesirable qualities of flavors and aromas, and the important points in the selection of high quality dairy prod-

ucts would enable the consumer to purchase wisely and economically the dairy products which should be a part of the daily diet in every home in the civilized world.

May the dairy industry never forget that the increased sales of dairy products depend on that pleasant, delicate flavor sensation which dairy products make on the palate of the consumer.

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Review Questions

1. What factors have guided man in the selection of foods?
2. Name the products judged in the Students' National Contest in the Judging of Dairy Products.
3. What is the Lür Brand?
4. Upon what is the Iowa State Brand for butter based?
5. What is meant by the term "eating quality" in dairy products?
6. What three sensations make up the flavor of a dairy product? How is each of these sensations derived?
7. Give five reasons for judging and grading dairy products.

CHAPTER II

BASIC PRINCIPLES OF ORGANOLEPTIC EXAMINATION OF DAIRY PRODUCTS

The experienced dairy products judge is generally convinced that no special acuity of the basic senses exists and that the judging of dairy products is merely a matter of noting carefully and interpreting correctly the sensory reactions after each product is sampled. The inexperienced beginner will attain the ability to judge dairy products accurately if close attention is paid to the delicate senses of taste and smell with which everyone is endowed. Some consider that the judging of dairy products is an art. On the contrary, the judging of dairy products is based largely upon science. However, the attainment of a high state of proficiency in organoleptic judgments may be considered as an art based upon scientific principles. The aim of this chapter is to treat some of the scientific aspects of organoleptic examination of dairy products adequately so that the beginner will progress more rapidly in learning how to judge dairy products than otherwise would be possible.

Physiology of taste and smell. Taste and smell are considered to be chemical senses inasmuch as the receptors for those senses respond to chemical stimuli. The sense of smell is far more sensitive than the sense of taste. The average person requires a relatively concentrated solution in order to get the taste sensation, whereas an odoriferous substance, a mercaptan for instance may be diluted to the extent of 1/23,000,000,000 of a milligram per ml. of air and yet be recognized as such by the sense of smell. The perceptibility of the sense of smell is far beyond that which can be detected chemically by the most accurate and painstaking chemist.

The taste receptors are located primarily on the sides and on the base of the tongue but may be found also on the soft palate and on the cheeks, particularly in young people. Papillae of various types can be noted chiefly at the tip, along the sides and at the base of the tongue. The taste buds with which the sapid

substance in liquid form must make contact before a taste sensation occurs are located in many of these papillae. Taste buds differ somewhat in their response to stimuli. The sour taste may be noted chiefly along the sides of the tongue, salt along the side and tip, sweet generally at the tip and the bitter taste at the base of the tongue. For this reason, the sample being tasted should be manipulated about the mouth and rolled over the tongue in order to give the taste buds opportunity to contact the sapid substance.

The centers of olfaction are located chiefly in the uppermost regions of the nasal cavity and not along the sides of the septum of the nose itself as commonly supposed. The olfactory itself, if spread out, would be about one square inch in area. Projecting from the light, yellowish brown center-of-smell area are tiny cilia, or fine hairs, which are excited by molecules of odoriferous substances. Since this area of smell is reached chiefly by eddy currents, rather than direct passage of air during inhalation, the odoriferous substance must be "sniffed" or "whiffed" rather slowly but strongly while respiration is stopped. During exhalation there is no appreciable smell sensation. Smell sensation may be excited by diffusion also. However, diffusion of the odoriferous substance is so slow as to be of no practical value in ascertaining the odor of a substance. Even with the nose filled with odor-laden air an odor sensation is not noted when the breath is held. With these facts in mind the judge must put more stress upon drawing in a full breath of air through the nose rather positively and prolongedly. Every judge knows that during mastication odors may be noted without smelling the product. During mastication, molecules of the odoriferous substance reach the olfactory area from the mouth. Therefore, during the "tasting" of dairy products the judge actually is sensing the odor and the taste of the product at the same time.

The role of the various senses in the judging and grading of dairy products. All five senses, sight, smell, taste, touch and sound are used in judging and grading dairy products. The extent to which each sense is used depends upon the product being judged. In the judging of dairy products beginners should associate all the senses with most of the emphasis on the senses of smell and taste.

1. Sight. Some of the good qualities and some of the defects of dairy products can be evaluated by careful observation. Among those factors which may be judged by sight are such items as style, neatness and cleanliness of the exterior of the package, neatness of finish, protection afforded by milk bottle closures, color, sediment collected on a disk or that visible in the products, melt down of ice cream and many other items which have a bearing on the quality of dairy products. As a rule the items which may be evaluated only by sight have a relatively low numerical rating on the score card or grading sheet. Nevertheless, they should not be slighted in judging. The good judge scrutinizes the product closely by sight in an attempt to correlate, if possible, certain deficiencies in the visible items with flavor quality. For instance, an untidy butter package, unclean milk bottle, carelessly bandaged cheese, all these can be evaluated by sight and furnish the judge a clue to the flavor quality. Should the judge see evidences of carelessness in workmanship, smelling and tasting of the product should be done carefully with the senses alert, in order to detect the possible associated defects. For example, if the judge upon inspecting a trierful of butter, notes a badly mottled color, he will very likely taste the sample with greater concentration of effort than he would if the sample were found to be uniform in color. Not only must the judge know what to observe in judging dairy products, but also must train the eye to detect at once, so far as possible, shortcomings in ideals established for the product. On the other hand, the judge must exercise caution to see that judgment of the senses of smell and taste is not unduly influenced by that which is visible to the eye.

2. Smell. The sense of smell probably has the most important role in the judging of dairy products. The dairy products judge is influenced very much by the sensation of smell in making the decision relative to the flavor quality of the product. This does not exclude tasting. As pointed out in the discussion on the physiology of the olfactory organs, the sample does not necessarily need to be "whiffed" to get the odor sensation as the air-laden odor may reach the sensory nerve area through the mouth during tasting. Odor and taste, combined with the feel of the substance in the mouth, make up the concept which is called "flavor." Dairy prod-

ucts are consumed not only for their nutritional value, but because they have a pleasing, satisfying and palatable flavor.

The olfactory quality of flavor contributes as much or more to flavor as the taste quality. Since flavor has the greatest numerical value of any of the items on the score cards used for scoring dairy products and odor contributes largely to the flavor, the sense of smell has an especially important role in the judging of dairy products.

3. Taste. Taste is a companion sense with smell in establishing the flavor of a product. As mentioned elsewhere, there are four fundamental tastes, sweet, sour, salt and bitter. In the grading of dairy products, with few exceptions, the product must be tasted. Not only will the taste reaction be noted at the time of tasting, but the odor sensation in the nasal cavity and the feel of the sample in the mouth will also be noticed. Thus the role of taste is more complex than the mere act of tasting. It involves the tactual and olfactory sensations as well.

4. Touch. Not only are the senses of smell and taste intermingled but the sense of touch, or pressure, is intermingled also. The sense of touch plays a part in the scoring of dairy products. To illustrate: The tongue and palate register the peculiar feeling of mealy, or salvy butter. They record, also, the sandy condition of ice cream. Pressure between the teeth determines the presence of undissolved salt or of crystallized lactose. The finger tips and thumb may be brought into use to substantiate the findings of the organs of the mouth. The fingers play an important role also in examining the body of butter and cheese. The tongue and the floor and roof of the mouth record the ease or difficulty with which the examined product goes into solution. The organs of the mouth, the finger tips and the ball of the thumb are all important in evaluating certain physical qualities which frequently introduce the judge to other defects which might otherwise be overlooked.

5. Sound. The sense of sound is sometimes used in judging dairy products. The judge can detect the relative size and distribution of the "holes" in swiss cheese by gently tapping the outside of the cheese with the fingers. The relative amount of free water in leaky textured butter can also

be observed by the "slushing" sound made when the plug is reinserted into the hole from which it was drawn.

Classification of tastes. Strictly speaking we experience only four taste reactions, namely, sweet, sour, salt, and bitter. Authorities agree on these four taste reactions. Some believe, however, that two other taste reactions occur, namely: alkaline and metallic. These may be, in part, tactual sensations and not true taste sensations. It is true that many flavors are sensed, as no doubt everyone has experienced, but the flavors noted are a composite of taste, touch and smell reactions and not of the true tastes alone. In addition, such feelings in the mouth as astringency, peppery, coolness, warmth, smoothness, numbness and others sometimes experienced in tasting are not taste reactions but are sensations of touch. They are nevertheless important attributes of tasting and should be considered fully. True basic tastes, sweet, sour, salt, and bitter may be sensed with the nose obstructed. In fact, when a person has a cold these taste reactions, aside from the feel of the food in the mouth, are sometimes the only components of the flavor which may be detected.

Classification of odors. Common experience indicates that the number of odors are many and varied. Attempts have been made to resolve these many odor sensations into basic fundamentals just as the many taste reactions were resolved into four basic tastes. Crocker and Henderson (1927) have made notable contributions in this field. Taking Henning's six fundamental odor sensations namely, spicy (cloves, cinnamon), flowery (heliotrope), fruity (apple, orange oil), resinous (turpentine), foul (hydrogen sulfide) and burnt (tarry, scorched substances), these investigators after careful study, reclassified them into the following groups, arranged in order of their preference by most people:

1. Fragrant or sweet.
2. Acid or sour.
3. Burnt.
4. Caprylic or goaty.

Recognizing that any odor stimulated receptors for these odors, they set up standards for many odoriferous substances based upon the correct quantitative mixture of the above fundamental odors. Having a range of intensity of stimuli for each of the four basic odors numbered from 0 to 8 they reproduced odors simply by mixing certain intensities of the basic odors together.

For example, 3803 is the four-digit symbol for acetic acid, where three indicates three degrees out of a possible eight for fragrance, all eight of sourness, no burnt and three out of a possible eight for caprylic (goaty).

Inasmuch as evidence points to the fact that odors are a composite of fundamental odor sensations, the dairy products judge should be alert to the possible detection of the individual components. While sense acuity may not be improved, the power of concentration, which is of primary importance in all tasting and smelling will be materially improved thereby.

Sensitivity of taste and smell. Much discussion has centered around the sensitivity of taste and smell of individuals and the effect of this sensitivity upon the ability of an individual to judge dairy products. Studies show that threshold values of individuals vary (King, 1937) and that some individuals are taste-blind to certain substances (Blakeslee and Fox, 1932). Some investigators have gone so far as to point out that very few people make good judges. That this is true is not beyond question. However, it should be stated that other factors beside sensitivity of taste and smell are involved in the making of a good judge of dairy products. Judkins (1943) points out from Whitaker's data that errors in judging flavors of dairy products are due to many considerations, chief of which are:

1. The individual lacks the ability to detect certain flavors.
2. The individual has a preconceived and incorrect terminology of certain flavors.
3. There are variations in the individual's sensitivity, that is, the amount of flavor which needs to be present for a given individual to detect it.
4. The individual may have a poor memory, lack interest or seem to have a poor mental attitude toward the experiment.
5. Counteracting forces — such as the personal feeling, health or general condition of the individual on the day he is judging.

Judkins believes that individuals can be grouped, so far as their abilities to judge the flavor of dairy products are concerned, into the following three groups:

1. Those who always find the product satisfactory.
2. Those who may find the product unsatisfactory but cannot tell why.

3. Those who are able to select satisfactory products and who are able to detect an unsatisfactory product and state the reason why.

Hollingworth and Poffenberger (1917) pointed out that the connoisseur is sensitive to minute differences in the flavor of wines, tobaccos, and other products and acquires a skill which is quite incomprehensible to the inexperienced. However, they attribute this skill in part only to special sensory activity, stating: "It is in large measure a matter of perception rather than one of sensation — a knowledge of what signs to look for and how to interpret these signs — rather than an increased sensitiveness to stimuli."

Experiences of the authors have led them to believe, despite marked differences in the individual sensitivities of taste and smell among tasters, that lack of sense acuity does not necessarily mean that such an individual will not be a good judge. A person endowed with normal senses of taste and smell, with proper training, may become a good judge of dairy products by diligent effort. Perhaps the greatest handicap of the beginner is not the inability to taste and smell, but the belief, which is purely psychological, that the ability to taste and smell is lacking. As has been already pointed out, sensitivity of taste and smell, important as it is, is not the limiting factor in determining whether a person will become proficient in the judging of dairy products.

Taste-blindness. Blakeslee and Fox (1932) have shown that approximately three people out of ten are taste blind to the bitter tasting chemical, phenyl-thio-carbamide, commonly called P.T.C., and that this lack of taste acuity for this particular substance is an inheritable trait. These investigators also report that taste-blindness for other substances has been noted. P.T.C.-treated paper prepared by the American Genetics Association lends itself well to classroom demonstrations in tasting. This treated paper is generally useful to point out that taste-blindness does occur with some individuals within a group, and it stimulates interest in tasting.

Being "blind" to a certain taste need be no cause of worry to an amateur judge. Other factors play important roles in dairy products judging. Literature reveals that some of the expert food tasters had no especial taste acuity as beginners but by concentration and application become very proficient in the field.

Saliva. Saliva plays such an important role in taste and in taste studies that the taster should be familiar with its origin, properties and functions. In order to cause a taste reaction the sapid substance must be in solution so that it can be carried to the taste buds. Not all dairy products taken into the mouth are in a natural state for being conducted to the nerve center of taste. They must be masticated, melted and diluted before a taste reaction occurs. To this end the saliva performs a primary function.

Saliva is secreted mainly by three paired glands: (a) the parotid, located in the cheeks with a duct, *the duct of Stensen,* opening from the inner cheek opposite the second molar tooth; (b), the submaxillary, the duct of which opens from the floor of the mouth to one side of the connecting membrane binding down the underside of the tongue; and (c) the sublingual which have several ducts opening beside this membrane. In addition some small glands scattered over the mucous membrane secrete a mucoid fluid (Best and Taylor, 1943).

Tasters have noted frequently that the saliva varies in viscosity and in amount. Experiments have shown that the saliva secreted by the sublinguals is usually thick and mucous, that of the submaxillary either thin and watery or thick and viscid, depending upon the stimulus, whereas that of the parotid is thin and watery. When a copious flow of saliva occurs as in normal mastication and tasting, the saliva is usually of the serous character, being mainly the secretion from the parotid glands. Best and Taylor (1943) give seven functions of the saliva, four of which are of interest to tasters. These are: (a) preparation of the food for swallowing by altering its consistency; (b) solvent action; (c) cleansing action; and (d) moistening and lubricating action.

Pavlov's famous experiments on reflexes give us an insight into the nature of the secretion of saliva. The natural secretion of saliva is brought about in two ways, either (a) through the stimulation of the nerves in the mouth by the presence of food or other substances, called unconditioned reflex, or (b) by the stimulation of sense organs other than taste, called psychic or conditioned reflex. Salivary secretion occurs readily when dairy products are taken into the mouth for tasting, the amount and nature of the saliva depending upon the product being tasted. In general, the introduction of a fluid such as milk into the

mouth, which needs no dilution for tasting, calls forth a mucous, viscid, salivary secretion whereas the introduction of a semi-dry solid, such as cheese, results in the secretion of a thick, viscid, lubricating, submaxillary saliva in addition to the copious quantities of the diluting parotid saliva. Manipulating the sample about the mouth stimulates the flow of saliva. In fact, chewing, smoking, the presence of salts, acids, flavored substances, dry foods, paraffin, inert substances, or the administration of dentist tools call forth a flow of saliva. These responses are inherent and should be used to the best advantage by tasters. On the other hand, Pavlov showed that the salivary glands could be conditioned to respond through the sight, smell, or thought of food or the sound associated with the preparation of dispensing of food. Thus the dairy products judge should look with eagerness and pleasant anxiety toward the judging of dairy products in order to stimulate the nerves to induce a generous flow of saliva.

Just as certain stimuli cause a secretion of saliva, other conditions, mainly of an emotional nature, may cause a temporary suppression of salivary secretion. It is the common experience of the coaches of dairy products judging teams that sometimes an outstanding student judge may not judge so well in a contest when surrounded by unusual conditions and working under an emotional strain. Other factors must necessarily enter into the cause of the lowered judging ability, but the possibility of suppressed salivary secretion affecting the taste reactions must not be overlooked.

Human mixed saliva contains about 99.5 percent water and 0.5 percent total solids. The solids are composed of salts and organic substances. There are also some gases in saliva. The chemical reaction of saliva varies. It is usually slightly acid. The pH ranges from 5.75 to 7.05, with 86 percent of the cases within a narrower pH range of 6.35 to 6.85 (Bodansky, 1934). Harrow and Sherwin (1935) point out that the pH of saliva varies in a rather definite manner throughout the day, rising sharply just after meals, but falling quickly to a point slightly lower than that occurring just prior to meals and approaching the neutral point between meals. These facts should have a bearing upon the optimum time of day at which to make taste studies.

Threshold values. Threshold values are the minimum concentrations of sapid substances which can be recognized upon

tasting or smelling. Threshold values vary with individuals (Josephson, 1946). Some individuals have lower threshold values than others. Those having a low threshold value for salt, for example, may be expected to detect a salty taste whereas those having a high threshold value may not be able to recognize the taste at all. However, the values are not fixed with the individuals but vary somewhat with the temperature of tasting (Henning, 1927).

Threshold values are somewhat difficult to compare, inasmuch as investigators used different technics. Applying a sapid substance to the tongue by means of droppers, tablets, pencils, brushes, sponges, or electric currents are some of the methods used. Inspection of some values given are of interest.

Parker (1922) selected the following as being representative of threshold values:

Sucrose, 0.02 M.* (0.685 percent solution).
Hydrochloric acid, 0.0025 M (0.009 percent solution).
Sodium chloride, 0.04 M (0.234 percent solution).
Quinine hydrochloride, 0.00004 M (0.0016 percent solution).

* Moles or molecular weights per liter.

Bailey and Nichols (1888) found the values as detected by male judges to be:

Sugar, 1 part to 199 parts of water (0.5 percent).
Sulfuric acid, 1 part to 2,080 parts of water (0.05 percent).
Salt, 1 part to 2,240 parts of water (0.045 percent).
Quinine, 1 part to 390,000 parts of water (0.00025 percent).

Beatty and Cragg (1935) stated that acids more sour than 0.0100 M (0.036 percent) hydrochloric acid, cannot be compared by taste measurements.

Fontana (1902) found the lower limits of taste to be

Sugar, 1.0 percent solutions.
Acetic acid, 0.25 percent solutions.
Salt, 0.2 percent solutions.
Quinine sulfate, 0.012 percent solutions.

Henning (1927) has summarized threshold values for sweet, sour, salt, and bitter substances reported in the literature, the threshold range of sugar being from 0.009 to 0.5 percent, hydrochloric acid from 0.0035 to 0.035 percent, salt from 0.006 to 0.5 percent and quinine sulfate from 0.00005 to 0.0005 percent.

Crocker and Henderson (1927) found threshold values for average good tasters to be as follows:

Taken as teaspoon sips (4 ml.)	Sweetness-cane sugar . . . . . .0.68 percent solution
	Sourness-tartaric acid . . . . .0.019 percent solution
	Saltiness-sodium chlor. (c.p.) .0.18 percent solution
	Bitterness-caffeine (u.s.p.) .0.0090 percent solution

Best and Taylor (1943) give the following as threshold values:

Sensation and Substance	Concentration
Sweet, cane sugar	1 part in 200 parts water
Acid, hydrochloric	1 part in 15,000 parts water
Salty, sodium chloride	1 part in 400 parts water
Bitter, quinine	1 part in 2,000,000 parts water

Research on threshold values for smell has not been so extensive as that for taste. In general the sense of smell is many thousand times more sensitive than that of taste. Best and Taylor (1943) give the following threshold values for some odoriferous substances:

Substance	Mgm. per Liter of air
Ethyl ether	5.83
Chloroform	3.30
Oil of peppermint	0.024
Iodoform	0.018
Butyric acid	0.009
Propyl mercaptan	0.006
Artificial musk	0.00004

Considerable emphasis has been placed on threshold values in tasting. The possibility of selecting low-threshold-value tasters in selecting a tasting panel should not be overlooked. However, the authors believe that in developing judges and graders of dairy products threshold values are in themselves not all important. Considering that sensory judgments must often be made between differences in taste stimuli, even below threshold values, and that much dairy product judging must be done in that realm far above the maximum threshold value, the beginner should not be discouraged if upon trial he is found to have a high threshold value.

Methods of applying taste stimuli. The method of introducing the sapid substance to the tongue in taste studies varied widely depending upon the information sought. In general, research workers studying taste reaction time or threshold values employ methods such as introducing the stimuli to the protruded tongue by means of a dropper, sponge, rod, brush, tube, or spoon in order to eliminate certain variables. Some even soak the solution in a pith and apply slices of the dried pith to various areas of the tongue while others use thickeners to keep the sapid substance on a special area. On the other hand, research workers interested in determining the taste of a specific solution are inclined toward permitting the subject to have free access to the

substance being tasted. Some others, however, limit the subject to only one taste reaction providing for that purpose an adequate quantity of the substance. Usually in comparative taste studies in which various solutions are being arranged according to concentration, free access to the solutions is found to be quite satisfactory. For this purpose, Crocker and Henderson (1932), Trout and Sharp (1937) and Fabian and Blum (1943) used small glass beakers permitting as many tastings as was found necessary to arrive at a definite judgment. With some modification, such a procedure is generally followed in milk judging. Other dairy products such as butter, cheese, ice cream and those which are more or less of a solid nature, are taken into the mouth for tasting, much the same as food is introduced to the mouth.

Judgment of differences in taste stimuli. In the judging and grading of dairy products the judge is often concerned with rating two or more products having the same flavor but varying in intensity. Here the flavor stimuli may be identical in quality, but differing in quantity. Judgments based on the amount of stimulus as well as its character are a part of dairy products' judging and should be recognized early by the beginner. This difference in taste reaction may be noted and evaluated although the stimulus is below the threshold value. For example, the threshold value for salt, according to Parker (1922), is slightly above 0.20 percent. However, Trout and Sharp (1937) demonstrated that differences in stimuli below these threshold values could be employed effectively in placing a 10-sample series in order of their concentration with high correlation. They concluded in part:

> "The sense of taste was found to be capable of discriminating changes as low as 1 percent in concentration of the sodium chloride solutions ranging in concentration from 0.13 to 0.20 percent. With the sodium chloride, sucrose, lactose, lactic acid, and quinine sulfate solutions, 10 percent changes in concentration were readily detected."

Experienced judges recognize these differences in stimuli which occur in the tasting of dairy products. Although the stimuli may be below the threshold level, they nevertheless recognize them as one of the "signs" in tasting and attempt to interpret them in the terms of some flavor defect.

Compensatory and competitive action of some food constituents. Varying intensities of saltiness, sourness and sweet-

ness are basic to most foods. This fact, as well as the knowledge of the influence which any one of these constituents has on the perceptibility of the others, or possibly upon other flavors, must be recognized by the dairy products' judge. These basic flavors contribute materially to the flavor of dairy products. It is commonly accepted that salt "brings out" the flavor of food. For this reason some people sprinkle salt on grapefruit or watermelon, add it to coffee, or incorporate a small amount of it into buttermilk and ice cream. Salt has been used throughout the ages as an adjunct to foods. Acids and sugars also contribute materially to the palatability of foods as well as to the nutritional value.

A brief review of the early literature on the blending of flavors was made by Trout and Sharp (1937). Kiesow (1896) studied various mixtures of cane sugar and sodium chloride solutions, and showed the effects of small amounts of the salt solution in neutralizing the sweet taste, depending upon the original concentration of the two solutions. At a concentration of one percent the ratio of sugar to salt solution necessary to bring about neutrality was found to be about 0.5 to 0.25; while at a concentration of 10 percent the ratio for neutralizing the sugar was about 0.5 to 0.03. Titchener (1901b) pointed out that both sour and sweet "contrast" with salt, a trace of salt being able to neutralize the water for a judge who gets a sweet taste. Titchener stated that bitter "does not contrast with any other taste, and hence cannot be eliminated by compensation." This investigator also mentioned the "neutralizing" of water by adding salt to it. Shore (1892) showed that leaves of Gymnema prevent one from tasting sweet and bitter, but have no effect upon salt or sour. Crocker and Henderson (1932) concluded that the "glutamic taste" is not unique, but is capable of being matched closely by a mixture of bitter, salty, sweet and sour tastes. However, these workers noted that in the synthetic mixtures the parts of the taste faded out, one at a time, irregularly, whereas the glutamic taste produced by a single material did not fade out.

Parker (1922) believed that in all the complexity of taste mixtures the elements remain essentially distinct, concluding that "competition rather than compensation seems to be the rule."

Recent research work on the ameliorating or impairing action of acid, salt or sugar on each other and on other flavors is

very limited. Fabian and Blum (1942) have recently contributed some data on the subject. They observed that sodium chloride reduced the sourness of acids and increased the sweetness of sugars. Conversely, all the sugars studied, sucrose, dextrose, fructose, maltose, and lactose, acted to reduce the saltiness of sodium chloride, and to varying degrees reduced the sourness of acids. On the other hand, all the acids studied except hydrochloric which had no effect, namely citric, acetic, lactic, malic, and tartaric increased the saltiness of sodium chloride, and to varying degrees reduced the sourness of acids. Hydrochloric and acetic acids had no effect upon the sweetness of sucrose whereas the remaining acids increased its sweetness. These observations have a direct application in the judging of milk. For example, in judging milk flavor routinely, a normal flavor sample of milk might taste unusually sweet and fine after having judged a distinctly salty sample. Trout and Sharp (1937) showed that approximately 10 percent of the sodium chloride was retained in the mouth when 10 ml. of a one percent solution was tasted for fifteen seconds and then expectorated. Of that retained, approximately 96 percent was removed by the first two rinsings, the first rinsing having removed almost 69 percent. Thus a sufficient amount of the saltiness of milk might be retained after tasting to influence the sweetness of the succeeding sample. More recent work by Josephson (1946) substantiates the compensatory and competitive action of the basic tastes when applied to certain dairy products.

Reaction time to taste stimuli. The interval of time between the application or introduction of the solution being tasted on the tongue and the appearance of the sensation, according to Hollingworth and Poffenberger (1917), is known as the "reaction time" to the taste stimulus. The reaction time to various stimuli as a factor in judging has received little attention. The length of time required to determine the flavor of a product is much less than commonly supposed, providing the smell or taste sensation is recognized at once. If these taste sensations are not recognized then the taster must repeat the tasting until a judgment as to the specific flavor is made. The interval of time required to determine the flavor may be divided roughly into three parts, (a) that required for the mechanics of tasting, (b) the reaction time to taste stimuli and (c) the time

required for making judgment. Proficiency in judging enables one to reduce to a minimum the time required for the actual mechanics of tasting and for making judgments. The reaction time to taste stimuli, however, is fixed by nature and cannot be altered appreciably.

The reaction time is not identical for all the basic tastes, sweet, sour, salt and bitter, but this time is comparatively short. This fact is not fully appreciated by the beginner and one often overlooked by the experienced judge. In judging milk Trout (1946) observed that the mean overall time for tasting and passing judgment on samples, was about 9 seconds and ranged from two to 24 seconds, depending upon the flavor encountered.

Data on the length of the reaction time for a specific basic taste, as reported by different investigators, varies slightly, but always shows that the relative reaction time increases in the following order: salt, sweet, sour and bitter.

Kiesow (1903) found the reaction time for the four different solutions to be as follows:

Salt	0.308 second
Sugar	0.446 second
Acid	0.536 second
Quinine	1.082 second

From these data it may be observed that the sensations of salt and sweet come very quickly as compared with those for sour and bitter. The reaction time for bitter was more than three times that for salt, and approximately twice that for sweet and sour. Vintschgau and Honigschmied (1877) showed that the time required to discriminate between salt and water was less than that required to discriminate other tastes and gave the following reaction times.

Sodium chloride	0.2766 second
Sour	0.3315 second
Sugar	0.3840 second
Quinine	0.4129 second

These investigators showed also that the reaction time at the base of the tongue was less than at the point as demonstrated by the following data: (Figures represent seconds.)

	Sodium chloride	Sugar	Quinine
At point of tongue	0.597	0.752	0.993
At base of tongue	0.543	0.552	0.502
Difference	0.054	0.200	0.491

Titchener (1901 b) observed that bitter was set up noticeably later than was sweet or acid. Hollingworth and Poffenberger

(1917) summarized as follows: "Lowering the temperature of the solution below that of the mouth does not affect reaction time to salt, but it lengthens the time for the other qualities. Raising the temperature of the solution above that of the mouth quickens the reaction to sweet, but lengthens the reaction to bitter and sour." Crocker and Henderson (1932) substituted caffeine for quinine hydrochloride for a bitter standard, in part because caffeine registers more rapidly and disappears sooner.

Taste sensitizers and taste inhibitors. Some substances seem to condition the taste organs for keener perception while others render them less able to perceive delicate taste reactions. These substances may be called taste sensitizers and taste inhibitors, or taste dullers respectively. Probably the two most common substances which condition the taste organs to keener perception of taste reactions, or which render them to normal sensitivity over a prolonged period of tasting, are salt and mild acids. Judges of dairy products have recognized for years the value of a saline solution mouth rinse, or the eating of fruit in order to recondition the mouth for tasting. Sugar has an inhibitory effect on tasting. It brings about so called "taste fatigue." The presence of sugar in foods in relatively large quantities seems to dull the sensitivity of taste very markedly. Cream and cheese are other products which adversely affect the sensitivity of taste. Burke (1938) believed that substances which lessened the sensitivity of taste actually "insulated" the tongue from the products. In this he is probably correct, for sugar, cream and cheese, which are known to impair taste sensitivity over a prolonged period, fail to stimulate a copious flow of saliva which plays a most important role in conducting the sapid substances to and from the taste buds. Conversely, salt and acids stimulate a generous flow of saliva which laves the organs of the mouth and washes taste reacting substances away from the taste nerve endings leaving them normal for subsequent contacts with other sapid substances.

Adaptation and adaptation time. Adaptation is the adjustment of a sense organ to the intensity or quality of stimuli, as adaptation of the eye to light, darkness and color. This adjustment to various stimuli is not confined solely to the sense organs of sight, but may be noted also, although probably to a lesser extent, in the senses of taste and smell. Just as the eyes of a

person stepping from the brightness of a noonday street into a darkened theatre become accustomed to the darkness, so do the olfactory nerves become adapted to the odor of ether which seemed so pronounced when the person first enters an odor-filled room. It is the common experience of dairy products judges that intensities of taste and smell first experienced upon tasting or smelling a sample are greater than succeeding ones. For example, a sample of salty milk tastes saltier when first tasted than when retasted. Therefore, when prolonged retasting of a sample is necessary, the taste organs are reconditioned at intervals. Fortunately, in routine milk tasting the flavors of the samples often differ so widely that the various samples themselves appear to keep the sense organs in good condition for prolonged work. The organs of smell seem to adapt themselves more readily to odors to which they have been exposed than the organs of taste do to the sapid substances being tasted.

The time elapsing between the taste or olfactory reaction and the passing off of the stimulus is known as the adaptation time. Apparently the adaptation time varies in length according to the stimuli and according to its pleasantness of reception. Thus the delicate, flowery odors of a perfumery are persistent over a longer period than the ether odors of a laboratory, the tobacco odor in a smoking room or the silage odor in a stable. Likewise, the adaptation time for the fundamental tastes, sweet, sour, salt, and bitter seems to vary, that of salt being much shorter than that for bitter.

The taster should have a full appreciation of the role of adaptation in all flavor work. Knowing that adaptation sets in immediately following sense stimulation, the judge will thus be alert to the first olfactory or taste stimuli which undoubtedly are more representative of the sample under study than any succeeding ones.

Value of retasting samples. Despite opinions to the contrary there is much merit in retasting products during scoring and grading. Just as a good ice cream judge will "condition" the mouth to ice cream before placing final judgment on the flavor of a sample, so must the judge of all dairy products recognize that the first taste stimulus may be out of proportion to succeeding ones after the taste buds have been "conditioned" to that particular flavor. Student judges sometimes feel that judg-

ment based upon the first taste should be final. This attitude connotes lack of faith in one's own ability. A second or third taste may lead to substantiating the first judgment, thus leading to greater confidence. Retasting does not necessarily lead the judge to change the first judgment. Rather the reverse is true. In this connection Trout and Sharp (1937) demonstrated the value of retasting by placing in order of concentration a 40 sample series each of sodium chloride and sucrose. The correlation of placement was increased from .84 to .98 between the first and fourth attempts to place them in order. (Figure 3.)

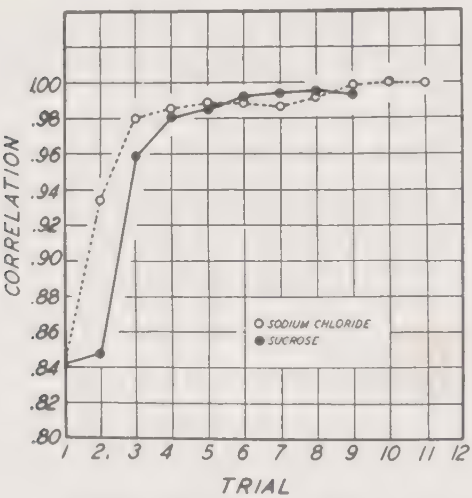

Figure 3 — Relationship Between the Accuracy of Arrangement of 40 Solutions in Order of Their Concentrations and the Number of Times the Series Was Tasted.

Anesthesia. The term "anesthesia" is used in this text to designate that temporary impairment of the senses of smell and taste which may result from smelling a pain producing odor such as strong ammonia or by tasting an extremely cold substance. The term is not used in the usual sense of rendering insensible to pain by means of anesthetics.

In the judging of ice cream, for example, the only sensation experienced at first may be that of extreme cold, a sense of feel rather than that of taste, the sense of taste being temporarily impaired by the extreme cold produced by the sample. Likewise, sampling of a product of high temperature produces a temporary pain and impairs the taste organs for some time. These effects are well known to experienced judges. Consequently, judges expect to experience a lag in taste reaction after introducing a sample of low temperature ice cream into the mouth. As the sample melts and approaches body temperature the true taste

reaction can be sensed. The beginner in dairy products judging should recognize that a temporary impairment of taste may be experienced under some conditions. It is a normal behavior and does not indicate a lack of ability in any degree whatsoever.

Development of skill in tasting. Tasters develop a high proficiency in the art of tasting not necessarily because of an increased sensitivity to stimuli, but primarily because they know what "signs" to look for and what the signs indicate. In training students in dairy products judging it is not essential to start them with the judging of dairy products. More rapid progress may be attained by giving the student access to certain solutions of known concentration embodying the basic taste substances. By placing a graduated series of basic taste solutions the beginner will likely notice certain peculiarities of the taste reactions for the first time and begin to have a stimulated confidence in the organs of taste and smell.

Trout and Sharp (1937) found that the tasting of pure solutions of various concentrations revealed to the beginner some of the "signs" and thereby helped demonstrate the fundamental principles underlying taste judgments (Figure 4). To this end solutions were used ranging in concentration as shown in the following table.

Table 1 — Series of Solutions Suitable for Studies to Develop Observation of Taste Sensations

Series No.	Solution	Range In Concentration, 10 Samples (Percent)	Geometric Decrease In Intensity	Range In Correlation Of Placement Obtained At 21° C. (4 Judges, Averaging 10 Trials Each)
1	Sodium chloride	2.0-0.078	1.5	0.9952-1.0000
2	Sodium chloride	1.0-0.192	1.2	0.9915-1.0000
3	Sodium chloride	1.0-0.424	1.1	0.9964-1.0000
4	Sodium chloride	1.0-0.640	1.05	0.9891-1.0000
5	Sodium chloride	1.0-0.9142	1.01	0.6746-0.9006
6	Sodium chloride	0.2-0.13	1.05	0.9564-0.9988
7	Sucrose	5.0-2.12	1.1	0.8963-0.9976
8	Lactose	5.0-2.12	1.1	0.9018-0.9818
9	Lactic acid (active)	0.005-0.002	1.1	0.8776-0.9455
10	Quinine sulfate	0.0002-0.0000848	1.1	0.3382-0.9374

At the close of some work on placing pure solutions, a student judge who was entirely unfamiliar with the oxidized flavor in milk did exceptionally well in placing samples having this flavor defect. After familiarizing himself with the oxidized flavor and

its intensity, this beginner placed a series of 16 milk samples in order with almost perfect correlation.

Some coaches of judging teams use many sapid substances to train students to discriminate between flavors. The number of

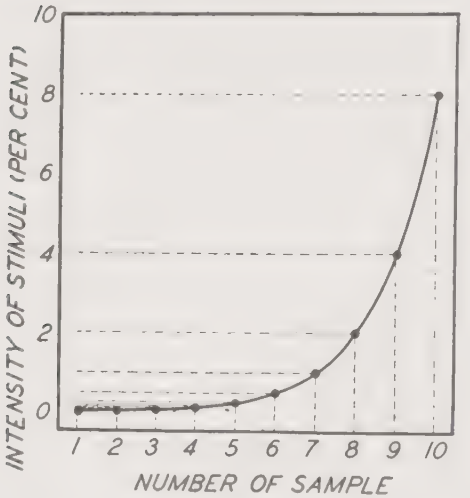

Figure 4 — Graphic Representation of a Series of Sodium Chloride Solutions Having a Geometric Decrease in Intensity (Factor 2). This Series Was Placed in Order of Concentration by Four Judges With a Correlation of 1.00.

substances used is almost unlimited. Coulter (1942) used the following solutions effectively:

Grams Per Liter of Water Solution

	Solution Number			
	1	2	3	4
Salt	0.68	1.36	2.04	2.72
Lactic acid	0.037	0.056	0.074	0.112
Sugar	2.736	5.47	8.21	10.94
Quinine	0.0016	0.0032	0.0064	0.0128

In preparing these solutions this coach made up the most concentrated solution (Solution No. 4), and from this solution dilutions for samples number 1, 2 and 3 were made. If distilled water is not used to make up these solutions the amount of reagent used may have to be varied to compensate for the hardness of the water.

For odor-bearing solutions, emulsions or suspensions, a great number of odoriferous substances are available. These include: vanilla, coumarin, rose water, peppermint, bergamot, onion, kerosene, gasoline, benzol, turpentine, ammonia, menthol, benzaldehyde, citric acid, acetic acid, butyric acid, fruit esters and any other substance that has a detectable odor. In smelling prepared samples of these substances the beginner must recognize that

compensation and competition between the odors apply in smelling as it does in tasting. Consequently, it is well upon reexamination of the series to reverse the order of smelling.

Optimum volume of the product to use in tasting. The amount of substance used in tasting depends upon the object of tasting and the substance being examined. Research workers studying threshold values generally used from 1 to 10 ml. of solution, although the amounts range from one drop to 30 ml. In many of the studies of Fabian and Blum (1943), the judges were permitted to have only one tasting of each solution for which 5 ml. of solution in a 100 ml. beaker was provided. Trout and Sharp (1937) allowed their tasters free access to the samples being examined. Measurements were made before and after tasting. Data obtained from nearly 300 measurements on various concentrations and on different taste solutions indicate that the taster normally uses approximately 6 ml. of solution for each taste. When difficulty was experienced in judging a series of solutions, it was necessary to retaste several times. From this work it appeared that it was natural for the unrestricted taster in normal work to take into the mouth a sufficient volume of the solution being tasted to yield a quick, full taste reaction. The importance of using a sufficient amount of the sapid substance to yield at least a normal taste reaction should not be minimized. In tasting milk, the taking of tiny "sips" should be discouraged. Likewise, in judging butter, cream, ice cream, and other dairy products the taster should be encouraged to take into the mouth a sufficient size sample to yield a normal taste reaction and yet one sufficiently small to permit its easy manipulation in the mouth. Restricting the taster to a single taste or to limited portions would seem to be psychologically unsound for best work.

Optimum temperature for tasting. Not all tasters are in perfect agreement on the optimum temperature of liquids for tasting. However, there seems to be a general agreement that the substance should be neither so cold nor so warm as to distract attention from the taste reaction. Trout and Sharp (1937), reviewing the literature on the subject, noted that most research workers in taste studies generally preferred temperatures ranging from 50° to 68° F. (10° to 18.8° C.). By actual experiment these workers demonstrated that a 10-sample series of salt, sucrose, lactic acid and quinine sulfate solutions could be placed

in order with higher coefficients of correlation at 69.8° F. (21° C.) than either at 35.6° F. (2° C.) or 95° F. (35° C.). It was believed that

> "The roles played by reaction time and by adaptation as influenced by temperature are very important in their effects on the placeability of series of solutions by taste. In comparative judging, these effects may not be recognized, or if observed, they will be recorded as a change in concentration of the solution. Also, distraction due to slight pain may have a hindering effect at extremes of temperature. Certainly, temporary anesthesia must be a factor to be reckoned with when tasting at 2° C. In these experiments, the temperature of 21° C. seemed to exhibit less 'distracting influences' in tasting than did that of either 2° or 35° C."

Experience has taught milk judges that temperatures slightly below room temperature, for example, around 60° F. (15.5° C.), are preferable for tasting milk to temperatures near 90° F. (32.2° C.). This temperature area seems to be in accordance with the optimum temperature for tasting as reported in the literature. The temperature of 60° F. (15.5° C.) is not cold enough to have a distracting influence and not warm enough to volatilize completely all the odors that may be present. Further volatilization may occur as the temperature of the milk is brought up to body temperature (98.6° F.). This factor should not be overlooked in judging milk.

Amount of retention of a substance in the mouth following tasting. Dairy products judges generally rinse the mouth out thoroughly after having tasted decidedly off-flavor products considering that partial retention of the off-flavor in the mouth would render a false taste reaction in the succeeding sample tasted. Limited data bear out the validity of this practice. Trout and Sharp (1937) found that approximately 10 percent of the sodium chloride was retained in the mouth when 10 ml. of a one percent solution was tasted, held in the mouth for 15 seconds and then eliminated. Approximately 96 percent of that which remained was removed by the first two rinsings. The first rinsing removed 69 percent of the sodium chloride. At the end of the fifth rinsing no trace of the solution tasted was evident (Figure 5).

The partial retention of substances being tasted may be sufficient to account for some of the discrepancies in reporting

taste sensation. Particularly would this seem to be true in tasting cheese, particles of which might lodge in the mouth and unless rinsed out, would influence the taste reaction of the next

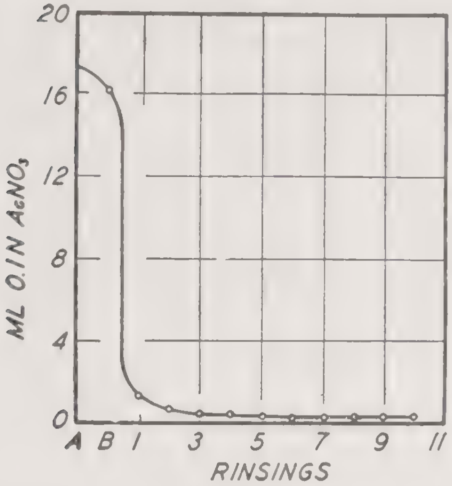

Figure 5 — Retention of Salt in the Mouth Following the Tasting of 10 ml. of a 1% Salt Solution (A) as Shown by Titration of the Residue (B) and of the Rinsings of Distilled Water.

sample tasted. On the other hand over-zealousness or indiscriminate freeing of the mouth of traces of the sample tasted may work to the disadvantage of good dairy products' judging. Unless the sample has an unpleasant taste or has some properties which makes conditioning of the mouth for retasting necessary, the freeing of the mouth of retained portions of normal products does not seem to be a wise procedure to follow. This conclusion is based on the experience of the authors in dairy products' judging and in working with experienced dairy products' judges, many of whom condition the mouth for tasting not by rinsing it out indiscriminately between samples, but by tasting several samples before placing final judgment on them.

Dilution of the product during tasting. A taste reaction occurs when a portion of the substance being tasted is conducted to the nerve centers of taste in a liquid form. Solid products must be liquefied in part but liquid products may be tasted with little or no dilution. During the liquefaction of solids by mastication, manipulation and by mixing with saliva, the taste reaction occurs as soon as a sufficient volume of liquid reaches the nerve centers of taste. The taster should be aware of the necessity of dilution of the sample during tasting. Excessive dilution of the sample being tasted as a result of prolonged holding and manipulation, as well as adaptation of the taste nerves to the

sapid substance, may convey a wrong impression as to the taste of the sample. Consequently, the taster should be alert to get the first taste reaction with a minimum of dilution. Considering the functions of saliva, as described in this chapter, it would appear that the flow of saliva resulting in the dilution of the sample, would vary with the viscosity and dryness of the sample.

Studies made by Trout and Sharp (1937) indicate that the extent of dilution during tasting depends not only upon the solution tasted, but also upon the duration of the tasting period. They found that the mean dilution in tasting a one percent salt solution progressively decreased from 12.87 percent for the first sample tasted to 4.23 percent for the tenth sample tasted. On the other hand when a series of 10 weaker solutions of sodium chloride (0.20 to 0.13 percent) were attempted to be placed in the order of their concentration, ten times, the dilution experienced was only 1.6 percent.

Other studies, in which 10 ml. portions of each sample of two 10 sample series of sodium chloride solutions ranging in concentration from 0.5 to 2.5 percent and 3.0 to 5.0 percent were tasted in order of their ascending concentration, showed a remarkably close agreement in the amounts of residue eliminated from the low and high concentrations. From these studies it was concluded that the concentration of the solution had no effect upon dilution during tasting.

In a study on the effect of temperature on dilution, progressively less dilution of the sample was found as the temperature of the solution was increased from 32° F. (0° C.) to 120° F. (48.8° C.). It was believed that this dilution had little influence upon tasting in comparison with the effect upon tasting caused by the temporary anesthesia resulting from the low temperature. In the tasting of milk an increase of 5. 3 percent was noted in the residue eliminated over the volume of milk taken into the mouth.

Taste of water. The taste of water is of interest to the dairy products' judge, particularly to those engaged in research or to those interested in training student judges. In some dairy products judging, such as evaporated milk and dry milk solids, water is used to reconstitute the product. In preparing a series of sapid substances of known concentration on which students may practice their skills of identification and arrangement in a prescribed order, the use of a "tasteless" water is absolutely

necessary. That potable waters vary markedly in taste has been of little concern heretofore. Too often water is considered as neutral so far as its taste is concerned. Trout and Sharp (1937), reviewing the literature on the taste of water, pointed out that in most taste studies unusual care has been exercised in securing water which was practically tasteless. Some investigators have been known to redistill water over alkaline permanganate in order to render it tasteless. To the experienced taster, distilled water has a taste reaction which makes possible its identity. Parker (1922) believed that the insipidity which was characteristic of distilled water was probably real tastelessness. On the other hand, Crocker and Henderson (1932) found that it took several days of tasting before they became accustomed to the "insipidity" of distilled water and that gradually a reaction was built up which made the water seem tasteless. For the major part of their studies, especially that involving weak sodium chloride, sucrose and quinine sulfate solutions, Trout and Sharp (1937) used a commercial spring water with satisfaction. The water was noted for its constancy of composition and tastelessness. They showed that a series of samples of water could be placed in order of their tastelessness by student judges with high correlation. It is believed that attempts at placing a series of samples of water from various sources offers a real possibility for an instructor to get a "tasting consciousness" in the minds of beginners. A good quality tasteless water must be employed in reconstituting evaporated milk and dry milk solids if the true flavor of the milk is to be determined. Unpublished data obtained at the Michigan Agricultural Experiment Station show conclusively that fresh evaporated milk reconstituted with water from a certain area always yielded a salty milk.

Time interval between tasting. The time interval between tasting and its effect upon sensory acuity remains uninvestigated (Fabian and Blum, 1943). However, various investigators believe in permitting certain time intervals between each tasting. Trout and Sharp (1937) report that Camerer (1885), in his extensive studies, permitted a pause ranging from 2 to 5 minutes between each two stimuli, to allow the organs to return to normal taste conditions. During this interim the judges were allowed to study vocabularies. Brown (1914) selected a rate of study which necessitated continued attention to the thought of tasting. About

8 series of 15 judgments each were made at a 50-minute sitting, or about 2½ judgments a minute. Brown believed that "on the whole, there seems to be no reason for supposing that the rapid succession of stimuli tended to dull the sensory acuity of any of the observers." However, he was aware that rapid judgment might affect following judgments because of the carry-over of the preceding stimuli or because of contrast stimuli, and stated "If the solution which is being tasted is stronger than the one preceding, there is a tendency to call it salt; but if it is weaker than the preceding, there is an equally strong tendency to call it water." Hambloch and Püschel (1928) permitted the judge to hold the testing solution in the mouth for about 10 seconds, after which the solution was ejected and the mouth was rinsed with drinking water. A pause of two minutes was maintained between tests.

In dairy products judging an experienced judge proceeds from sample to sample without conditioning the mouth between each tasting unless an especially intensive or repulsive stimulus was experienced.

Time of day for tasting. The best time of day for tasting has been established by practice rather than by research. It coincides approximately to those periods at least two hours after having eaten and extending up to the time for the next meal. Research studies have furnished some data supporting the belief that such periods lend themselves best to taste studies. Immediately after a meal the thought of food sets up a negative reaction in the mind. At that time the thought of food is not conducive to the flow of saliva as a similar thought of food might be a few hours later. As has been stated previously, a copious flow of saliva is believed to be essential in tasting work. This flow is best attained when the taste of food is not antagonistic or at least not neutral to the mind of the taster. Furthermore, the pH of saliva, which may or may not affect the taste reactions appreciably, varies in a rather definite manner throughout the day, rising sharply just after meals, but falling quickly to a point slightly lower than that just prior to meals and approaching neutrality betwen meals (Harrow and Sherwin, 1935).

Camerer (1869) in studying the effect of the time of day upon the threshold value of salt, tasted a series of six solutions from 10 to 12 o'clock in the morning and from 8 to 10 o'clock in the evening, fully two hours after meal time in each case. His

studies showed the time of day to have little effect, although in the case of one judge there was a tendency to favor the evening as the better time.

Titchener (1901a) recommended against taking any considerable amount of strongly flavored food shortly before tasting, since "the organ may be partly exhausted before work begins."

Hambloch and Püschel (1928) allowed two hours to elapse between meal time and the beginning of tasting.

Baten (1945) in his studies on tasting apples, found little difference in the reliability of taste judgments when the tasting was done in the morning as compared with that done in the afternoon.

Commercial dairy products' graders, generally as a result of experience, follow the practice of delaying the judging of dairy products immediately after eating but when judging is begun continue up to and beyond the next regular meal time. The writers believe that this practice should be followed in routine dairy products judging in order to attain best results. However, experience has shown that individual samples or just a few samples may be reliably judged at one time of the day as well as at another.

Time required to make a flavor judgment. The inexperienced judge is generally amazed at the comparatively brief time required to sense the flavor of a substance tasted. Considering the briefness both of taste reaction time and the onset of adaptation it must necessarily follow that the whole procedure of sensing the flavor and passing final judgment requires only a few minutes of time. Several factors will affect the time required to judge a sample for flavor, such as intensity of stimuli, nature of stimuli, nature of substance being tasted, reaction time, adaptation time and whether or not judgment is desired on the single individual sample or upon its relationship to other samples within a series. Trout and Sharp (1937) recorded the time required for the placement of each of 1,057 10-sample series of sodium chloride, sucrose, lactose, lactic acid and quinine sulfate solutions of various concentrations. The mean correlation of placement for the four judges taking part ranged from 0.8259 to 0.9262 with a mean overall time of 5.04 minutes per series. This represents a high correlation of flavor judgment with the average speed of 30 seconds per sample. Because of the small difference in stimuli among some groups of samples, individual samples had to be

tasted repeatedly, which resulted in the relatively long tasting time per sample when the sample was to be placed in a particular place in a series.

On the other hand it was noted that the time required to judge a single sample required usually between five and ten seconds. When samples were held in the mouth a timed fifteen seconds, as was done in a part of the study, the comment was made that the period of tasting seemed unusually long. The time reported by them for judging of individual samples, five to ten seconds, is in keeping with the recordings made by Trout (1946) in routine judging of milk for flavor in which the mean time for tasting and passing judgment on the flavor was about 9 seconds. When it is considered that the taste reaction time as being, at most, slightly more than one second, one is inclined to look upon with suspicion at the actual length of time often required in passing judgment on taste sensations and questions if the extended time actually is conducive to the best judging.

Selection of group size for study. In arriving at the number of samples to select for study in testing proficiency in judging, it must be borne in mind that the larger the number of samples which can be conveniently used in the group the less likely the beginner is to make a correct selection by random judgment. For example, in a 10-sample series, there are 3,628,800 possible arrangements. Even though outstandingly superior and inferior samples may be present, the odds of placing the remaining eight by random selection is one in 40,320. It is believed, therefore, that merit exists in selection of quite a sizeable group for study, keeping the number of samples within practicability of management. Sometimes unmerited emphasis is placed on proficiency in judgment when a low number series, 4 for example, are correctly ranked. Little real proficiency in judgment may actually exist. Should the end samples be determined, the remaining two might be selected at random on a 50:50 chance, thus real proficiency in judging is not shown. Should a low number series of pure solutions be used for tasting, it would seem advisable to furnish the student an assortment of several series of samples each of which varies in concentration, and ask the student to group and rank them according to taste. In this way the student must not only identify the sapid solution, but must determine its rank with respect to the others as well.

Probability of correct placement of a series of samples by random selection. In the training of student dairy products judging teams, occasion is sometimes taken to have students place in order of increasing or decreasing intensity of flavor a series of samples of pure solutions of known concentrations. Such a procedure gives to the student early confidence in his ability which is difficult to secure elsewhere. The probability of selecting at random the sample of highest or lowest concentration will be equal to 1/n. Thus in a series of 10 samples the chances are one in ten that a person could select a desired sample by random alone. On the other hand, the odds of placing in correct order a series of samples by random selection is equal to the product of n, n-1, etc. Thus in a 5-sample series there are 5 x 4 x 3 x 2 x 1, or 120 possible different orders of arrangement. This can be seen best as follows:

Number of samples	Probability of perfect order by random selection	Number of arrangements possible
1	1:1	1
2	1:2	2
3	1:6	6
4	1:24	24
5	1:120	120
6	1:720	720
7	1:5,040	5,040
8	1:40,320	40,320
9	1:362,880	362,880
10	1:3,628,800	3,628,800
11	1:39,916,800	39,916,800
12	1:479,001,600	479,001,600
13	1:6,227,020,800	6,227,020,800

Calculation of accuracy of placement. In evaluating proficiency of judgment in ranking a series of samples of various intensities of flavor, it is well to bear in mind that the mere sum of differences in rank between that of the official judge and that of the student judge shows little proficiency in judging unless the sum of the differences is extremely low. This was pointed out by Trout and Sharp (1937) and Baten and Trout (1946). The coefficient of correlation of each individual judge's placement may be calculated from the ranks, however, by using the formula proposed by West (1918),

$$rV_xV_y = 1 - \frac{6\Sigma\,(V_x - V_y)^2}{n(n^2 - 1)}$$

in which ${}_{r}V_{x}V_{y}$ equals the coefficient of correlation between the official and the individual rank; Σ equals the sum; V_x, the official rank; V_y, the individual rank; and n, the number of samples in the series.

Undoubtedly, in the training of students to select by taste alone a series of samples and place them in correct order, the instructor will not wish to take the time and trouble to calculate the coefficient of correlation of placement by use of the above formula, accurate as it is. In this case recourse may be had to the sum of differences between the correct and the student ranks of the individual samples. However, this method must be used with understanding. It must be emphasized that only extremely low scores by this method show any proficiency in judging. For example, Baten and Trout (1946) showed, in placing in order 1000 seven-sample series at random, that little proficiency in judging may be shown unless the sum of differences score was ten or below.

Judges and judging panels. The consuming public cannot for long be ignored in studies involving the quality of foods for in the final analysis the consumer *is* the final judge. Platt (1931) states: "In scoring food products the 100 percent standard at which we aim for our products is that appearance, texture, odor and taste which *the public likes best.*" However, it is not always possible to secure consumer reaction in regard to a product at a time when the opinions will do the most good. Consequently the food industry resorts to the judge or the judging panel which is the expedient best suited for the purpose of getting reactions on quality. From judging panels the food industry expects to obtain the nearest approach to consumer reaction. In this respect the dairy industry is no exception. There is this exception, however. It is believed that standards of quality for the various dairy products acceptable to the public have become fixed to the extent that judges knowing those standards can pass judgment reliably on samples of the products. The same is true also of the tea and coffee industries. Nevertheless, the reliability of judgment should increase when a group composed of more than one judge known as a judging panel passes judgment upon the product. Platt (1931) believed that since it was difficult to get together a large number of judges, preliminary conclusions should

be submitted to about three judges, but more important conclusions should involve five to ten judges.

In routine dairy products judging two or three judges usually pass upon the samples. In contest judging the official judging is done usually by three selected judges recognized for their dairy products judging ability. Trout and associates (1942) observed that the judgments of five selected judges were for the most part within a narrower range than those of the larger group of judges. It is generally recognized that numbers of judges do not necessarily result in more reliable judging. Concerning milk tasting Trebler (1935) states:

> "Consistent tasters are a little bit hard to find. Most plants are exceedingly careless both in picking the men and the place for tasting work in spite of the fact that this should be one of the most important routine tests. A definite technique should be followed both for picking and occasionally checking the tasters and for doing the routine tasting every day. In order to exaggerate the commercial conditions to some extent it would seem preferable to hold all samples for 48 hours at 40 deg. F. and then heat them in a water bath to about 80 deg. just before tasting. The opinion of one good taster is worth a great deal more than the average opinion of a lot of people who have no particular ability or interest in tasting.
>
> The most consistent tasting results can be obtained by working in a quiet, comfortably warm room and by never tasting after heavy meals or right after smoking or after chewing gum, tobacco, cough drops, or other materials with strong flavor. A good taster should be capable of picking samples with even slight off-flavors over and over again, in a blindfold test, even if he has a cold or is otherwise indisposed, as long as his nose and throat are not clogged up. Contrary to general opinion there is no limit to the number of samples an experienced taster can taste in one day. There are indications that a man's sensitiveness is increasing rather than decreasing as the number of samples increases. The plant manager should insist that tasting work be given the same status as, for instance, bacteria count or fat tests for which adequately trained men and working facilities are usually provided."

The judging panel should always be selected with care. Often many of those originally selected may have to be excused for one cause or another. Of 25 judges originally selected for taste studies, Fabian and Blum (1943) eliminated 10 for various reasons such as carelessness in tasting, inconsistency and very

limited availability. By testing thoroughly the acuity of taste and smell of 64 judges, King (1937) finally selected a panel of 14 judges for judging flavors in bread. The test involved tastings in duplicate of chemically pure solutions of sodium chloride, sucrose, lactic acid and caffeine; smelling of substances such as benzaldehyde (almond-oil odor), citral (lemon-oil odor), coffee, menthol, oil of turpentine, and a 10-percent aqueous solution of ammonia as well as a yeast dispersion in water and 95 percent alcohol; and finally placing in order 32 slices of bread according to increasing quantities of test materials added to it. This selected panel was somewhat better able to duplicate its judgments for taste of the bread than the larger group.

Platt (1937) believed that a great deal of work has been done on consumer preference tests in which the results were reported and accepted without any knowledge whatsoever of the degree of reliability. Platt maintained that underlying a consumer preference test were five major assumptions which should be considered seriously:

1. The judges are fairly representative of the whole population concerned.
2. Preference expressed in the test is the same as would be found if the some foods were eaten under normal conditions.
3. Reaction of the same judge to the same food will continue through the test.
4. Difference between two samples is greater than that between successive lots of batches of the same sample.
5. Preferences expressed represent reliable, reproducible decisions and not mere guesses which may be easily reversed on later trials.

Consequently, it would seem that in evaluating the flavor of dairy products, whether by an individual judge, a selected panel or by a cross section of the public, that care should be exercised in selection of the group if reliable results are to be attained. On the other hand, some investigators feel that consumer reaction studies are of doubtful value. They feel that the real test is the willingness of the consumer to accept the product if given an opportunity to buy it.

Some psychological aspects of judging. Certain psychological aspects of judging have a bearing upon the rate of progress which a beginner makes in learning to judge dairy products. The experience of the authors in the training of student judges has

been that many students, the majority in fact, begin dairy products' judging with too little confidence in their abilities to taste and smell. Just why a person will apologize to himself or openly for his inability to taste and smell and have so much confidence in his eyesight is difficult to explain. "I can't taste very well," "I have a cold," or "My smeller isn't very good," are common expressions of beginners who lack confidence in their ability to taste and smell. Likewise, the expression "I saw that with *my own eyes*" is an indication that the same beginners do not question the eyesight, defective as it may be. There is no reason to believe that man in general is endowed with a sense of good sight and with poor senses of smell and taste. Belief in special sensory acuity in the one and lack of it in the other seems to be a trait of human nature. In time, experience in judging will overcome these inferiority feelings toward judging. Recognition of the psychological trait will aid the beginner in overcoming the inferiority toward taste and smell acuity sooner than would be possible otherwise.

Comparative abilities to score or to criticize samples. Dairy products' judges must both score or grade the product and indicate the defects if any are present. There are two approaches in training judges toward this end, either placing a score on the product first and then giving a reason for so doing or vice versa. Some studies made by the Committee on Judging Dairy Products, American Dairy Science Association (White et al. 1940), furnish some data which should be of some value in learning to judge dairy products. Data secured on judgments of 69 student judges in scoring and criticizing 10 samples each of milk, butter, cheese, and ice cream showed that the student judge who could detect the proper defects and their intensities in the samples could score them reliably. On the other hand, the student judge who could score the samples reliably was not so able to criticize the samples accurately for defects. This indicates that in the training of judges, emphasis should be placed primarily on the proper identification of defects and secondly upon the score rating. By the time the beginner recognizes with assurance the defects in a dairy product he will likely know their evaluation. In naming flavor defects the beginner should especially avoid the tendency toward repeating the flavor defect. Brown (1914) pointed out the tendency toward "iteration" on the part of the

judge. This means that once a judge notes that one criticism is encountered more frequently than another, there is a tendency for the judge to make this criticism the predominant one. This may be demonstrated in dairy products judging by the tendency of an inexperienced judge to designate more defects of one kind than another, once the tendency is in that direction. For example, one judge may interpret the majority of the off-flavors of milk as "feedy" while another may be inclined toward calling the off-flavor "oxidized."

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Review Questions

1. Where are the taste receptors located?
2. In what area of the mouth is the sour taste detected? The salt taste? The sweet taste? The bitter taste?
3. Name the senses used in judging dairy products in order of importance.
4. Name the four groups of odors.
5. Define "threshold" as applied to taste and smell.
6. What is meant by taste blindness?
7. By what glands is saliva secreted?
8. Give four functions of saliva.
9. What is a taste sensitizer?

10. What is a taste inhibitor?
11. What is meant by adaptation time?
12. What is meant by the term "conditioning the mouth"?
13. What is anesthesia as applied to tasting?
14. What four solutions are generally used in taste studies?
15. How large a sample should be used for tasting?
16. What is the optimum temperature for tasting?
17. What is meant by "compensation" as applied to some food constituents? Give an example.
18. Calculate the number of possible arrangements of a 10-sample series.
19. How does salt affect the taste of sugar?
20. What is meant by "competition" as applied to some food constituents? Give an example.
21. To what extent is a substance retained in the mouth following tasting?
22. To what extent does dilution occur during tasting?
23. What is thought to be true tastelessness of water?
24. How long should be required to make a taste judgment?
25. Are the taste reaction times of equal length? If not, how long are they and in what order?
26. What arguments can you advance as to the best time of day for judging dairy products?
27. What is meant by the "signs" of tasting?
28. Give reasons why some persons never become proficient at judging dairy products.
29. What is meant by "taste blindness"?
30. What is the merit of retasting samples before making final judgment on them?
31. What is meant by the "tendency toward iteration"?

CHAPTER III

FUNDAMENTAL RULES FOR SCORING AND GRADING DAIRY PRODUCTS

Mastery of certain techniques and a good understanding of the procedures in examining dairy products will enable one to become a good judge sooner than would be possible otherwise. Time is always an element to be considered in dairy products judging. Efficient use of time in scoring a number of samples actually results in the judge having more time at his disposal for scoring and rechecking each sample. Hence, knowing that time is available, the judge will avail himself of the opportunity for more concentration and thought without being rushed for lack of time. Mental poise and calmness in scoring dairy products are generally reflected in superior work and more accurate judgment, which are likely to be lacking when the judge is hurried and, thus, confused. To enable the prospective judge to make the best use of his time, to develop concentration, to work effectively and to gain confidence in judging and grading dairy products, the following fifteen rules have proved to be very valuable:

1. Be in physical and mental condition for scoring. This implies good health, physical comfort and mental poise. Certain suggestions have been found helpful. The eating of a heavy meal just prior to judging seems to dull the appetite, and to destroy much of the enthusiasm for tasting and the sensitivity of taste. Furthermore, the often retained, pronounced flavor after-effects of eating some foods may confuse the judge in ascertaining the delicate flavors of the products being examined. Consequently, if it can be avoided, never judge after having eaten a heavy meal and especially after having eaten foods of strong flavor such as cabbage, turnips, or onions.

The use of tobacco previous to judging is both questionable and debatable. While it is believed that the use of tobacco is generally detrimental to the development of the senses of taste

and smell, it must be admitted that some dairy products' judges noted for their abilities to judge are inveterate smokers. Frequently some contestants in the Collegiate Students' International Contest in the Judging of Dairy Products relate in a boastful spirit how they won high standing by smoking a cigarette just before entering the contest, thus intimating that the use of tobacco is not harmful to one's judging ability.

The use of mild-flavored pepsin chewing gum prior to judging is considered beneficial to the flow of saliva thus preparing the tongue and palate for the sapid substances. Some judges even prefer paraffin to chewing gum. In addition to stimulating the flow of saliva, the act of chewing appears to have a nerve quieting effect, which often is beneficial to student judges who are about to enter a judging contest.

The room in which the scoring is done should be clean, well ventilated, well lighted and tempered to contribute to the physical comfort of the judge (Figure 6). Wash room facilities should be available. Both the mouth and nostrils should be washed with plain water prior to judging. Likewise, the hands should be scrubbed, using a non-fragrant soap.

Figure 6 — Dairy Products Should be Scored in a Clean, Well-Lighted, Well-Ventilated Room Free From Foreign Odors.

2. *Know the score card or the ideal set up for each product.* The score card is one of the tools of the dairy products' judge. Learn, for permanent retention, its various items and the relative importance of each. Be able to recall instantly the numerical value of each item.

3. *Learn the grades of each product and the defect intensities allowed in each grade.* This means a thorough study of the many flavors and defects current to each product and the relative desirability or undesirability of each in terms of numerical values. Thus, to judge a product one must know what to expect in the way of quality of each product. This information may be gained in part through actual experience in processing or manufacturing the product, by carefully studying the chapters in this text dealing with each product, and by working with an experienced judge of each product.

4. *Have the samples properly tempered.* Since both the flavor and the body and texture can be determined best when the products are neither too cold nor too warm, each product should be tempered specifically for that product. Thus, ice cream tempered around 5° to 10° F. (−15° to −12.2° C.) and butter, cheese and milk tempered at about 60° F. (15.5° C.) is the most conducive to proper sampling and to the study of the various qualities. If the products are too cold, the taste buds may be temporarily anesthesized during which time some of the delicate, elusive flavors may pass off undetected. On the other hand, if the products are too warm, an accurate evaluation of some of the qualities is very difficult.

5. *Secure a representative portion of the sample to be judged.* Not only should the portion be representative, but it should be taken accurately as well. If the trier is used in sampling, turn it one-half turn only, removing the sample quickly by applying a slight back pressure at the handle as the trier meanwhile is being withdrawn. The sample thus obtained will exhibit a clean-cut surface. Regardless of the type of sampling tool, always cut out the portion to be examined, if possible, rather than scraping, compressing, or twisting it out. Avoid taking the sample from near the edge. Never take a surface portion, or a trier plug which touches an opening from where a previous sample had been removed. In case of liquid products, as milk, buttermilk, or cream, be certain the product is well mixed before sampling.

6. *Observe the aroma immediately after removal of the sample.* This is a good judging habit to form early in one's judging experience (Figure 7). Some aromas become less intense and disappear, in part at least, when exposed to the air. Thus, the best time to smell a sample is when the freshly cut surface is first ex-

Figure 7 — Student Judges Scoring Milk. Note That the Odor is Observed Immediately After Taking the Sample.

posed to the air. If the aroma is not observed then, its true intensity may never be recorded. Other qualities of the product may be examined after noting the smell, since they remain fairly constant.

The importance of examining the aroma of the sample immediately upon removal of such sample cannot be overemphasized. Observation of experienced graders over a considerable period of years has been that the most consistent graders invariably are the ones who carefully and conscientiously observe the aroma prior to tasting the sample. The relative sensitivities of the organs of taste and smell have been fully discussed in Chapter II. It is well to repeat here that the nose is far more sensitive than the tongue.

> "As little as one billionth of a milligram of an aromatic vapor is detectable by the human nose. In order to taste the same substance, the tongue requires a million times as much. The significance of this ratio is not generally appreciated by food processors."*

7. *Introduce into the mouth a sufficiently large volume for tasting.* The tendency of beginners is to evade this point. Sometimes attempts are made to pass judgment on a product without

*Food, Materials and Equipment, March, 1945.

adequately tasting the product. The sample should be large enough that delicate flavors may be detected, and yet sufficiently small to permit easy manipulation of the warmed sample in the mouth. Be in no hurry to expectorate the sample. It should be rendered completely liquid and warmed to body temperature before being rejected. Get the feel of the sample about the mouth. Hold each sample approximately the same length of time in the mouth regardless of the quality of the product. The sample tasted is rarely swallowed and then only on specific occasions.

8. Fix the proper quality ideal in mind. This can best be done by working closely with a sample recognized as having superior quality. If working with an experienced judge, notice carefully the qualities of the samples which merit a high score. Work with them until the flavor is definitely fixed in mind. Learn to recognize when and in what respect a sample fails to compare favorably with the ideal. Without the attainment of this mental guide or standard, the amateur judge has no "yardstick" by which to measure the products. The earlier the ideal quality of a product is grasped the sooner will the beginner become proficient in judging and grading dairy products.

9. Observe the sequence of flavors. Notice particularly the first tastes and odors which are sensed. Observe whether they change or are constant. If they gradually fade out, note what others, if any, take their places. The sense reactions for specific flavors remain the same. They may be depended upon to give the same sense sensations the next time they are brought into contact with the sense organs. Remember these sensations and correlate them as early as possible with the specific flavor. After expectorating, note how long before the taste sensation disappears. Observe whether the taste sensation tends to disappear at once or whether it persists for some time. These are all indicators of flavor qualities which the good dairy products judge never overlooks.

10. Recondition the mouth occasionally. The mouth should be cleansed or reconditioned at intervals of tasting, especially after having examined a poor sample. This may be done satisfactorily by rinsing the mouth with clean warm water or warm water to which a small amount of salt has been added. Some prefer conditioning the mouth by eating portions of sound firm fruit, such as an apple or a pear. Rinsing the mouth with water

or with one of the solutions reconditions the mouth satisfactorily after having tasted milk and ice cream. However, the use of salt water or fruit seems best suited for conditioning the mouth after having tasted butter and cheese. While some products such as buttermilk, cultures, or cultured cream appear to be conditioners in themselves, it is well to rinse the mouth occasionally with clean warm water to aid in keeping the mouth in condition to detect mild, elusive flavors.

11. Practice introspection. That is, close the eyes and mind to the world about you and practice self examination so far as tasting is concerned. Look back into your own mind and make mental records of the taste and smell reactions. In other words, concentrate upon the sample being examined to the exclusion of everything else. Practice concentration during scoring of a sample until it becomes a fixed habit of judging. Relax after having finished scoring the sample. Sustained concentration is tiring. Unless accompanied by alternate periods of relaxation, concentration may finally undermine the mental poise so necessary to good judging.

12. Do not be too critical. Observe carefully the taste and aroma of the sample, but do not form the questionable habit of trying to find objectionable flavors which may not be present. Such a practice contributes much toward the improvement of the imagination, but does little to increase one's judging ability. It often leads to the habit of suspecting the presence of undesirable flavors in every sample, which may or may not be the case. However, be certain that the sample has been well examined and whether defects are present. Give the sample the benefit of the doubt. Above all, keep an open mind in judging.

13. Check your own scoring occasionally. This can best be done by comparing the flavors of two or more identically scored samples and observing whether the flavors are scored consistently. Frequently, a good check on consistency of scoring should be made by re-scoring some samples without knowing their identity. Re-scoring unknown samples identically with the first scoring contributes much to the establishment of confidence and mental poise in the developing amateur judge. Every student judge should submit himself calmly to such a check in order to ascertain whether he is doing consistent work.

14. Be honest with yourself. Make yourself use independent judgment. Judge the sample itself. Do not be influenced by the name, the trade-mark on the package or by the score previously given a like product from a particular plant. Products of some plants have certain distinguishing characteristics which may reveal the identity of the sample despite all precautions to obscure the identity of the sample. Have no part in attempting to identify samples set out to judge. Concentrate on judging the samples at hand.

Student judges particularly should avoid trying to "judge the judge," but should score the product conscientiously, using independent judgment. He should keep a straight face and by so doing avoid telegraphing his observations intentionally or otherwise to another judge. Make your own decisions, and after arriving at a conclusion, believe in your own judgment until shown otherwise.

Polonius' advice* to his son,

> "This above all: to thine own self be true
> And it must follow, as the night the day;
> Thou canst not then be false to any man,"

is a good precept to follow in judging dairy products.

15. Recognize the fact that practice and experience are essential to the development of judging ability. Be assured that one must practice judging if he is to develop the ability to taste, smell, and distinguish the delicate, often elusive flavors of dairy products. Do not become discouraged too easily. Believe that you have adequate senses of taste and smell for judging dairy products. Frequently, all that is needed to reveal powers of taste and smell is training and practice. Concentration, perseverance, and continued actual judging practice will yield astonishing results.

**Hamlet*, Act. I, Scene 3.

Review Questions

1. Name the 15 basic rules for judging and grading of dairy products.
2. What influence may the eating of certain kinds of food have upon the accuracy of taste?
3. How can the mouth be "reconditioned" for tasting?
4. Why is cutting out a portion of a sample for observation rather than scraping it out important?
5. What is a good temperature for judging ice cream? Butter?
6. What is meant by "sequence of flavors"?
7. Why is it considered important to observe the aroma *immediately* after withdrawing the sample?
8. How may one gain a knowledge of desired qualities of dairy products?
9. What is meant by "introspection"?
10. Why may the habit of being unduly critical of samples be a handicap to the development of judging ability?
11. How can one check his own scoring ability?
12. Name some indications of flavor quality as manifested in tasting.

CHAPTER IV

SCORE CARDS AND THEIR USE

A score card is a tabulated list of the factors contributing toward the quality of a product with a numerical value assigned to each factor. These factors are usually arranged on the card in the order of their importance. The sum of the numerical ratings or evaluations of all essential factors which go to make up a theoretically perfect product is always 100. Thus, the score card becomes a numerical standard by which the quality of the various dairy products is measured.

In scoring certain dairy products, the use of laboratory equipment and facilities is necessary to determine the rating of some of the factors. This may prevent the complete scoring of the product in one period. Consequently, in scoring such products at dairy products' exhibits or in student judging contests where laboratory equipment is not available or when results are wanted immediately, only those factors that can be readily determined are considered. A card listing those factors with their values is known as an "abridged" or student score card. Obviously, the sum of the numerical ratings on the "abridged" or student score card is always less than 100. For quick results these abbreviated score cards are useful in comparing the quality of different dairy products.

The educational value of score cards in allied branches of the dairy industry, such as the dairy farm score card and the score card used in dairy plant inspection,[1, 3] has long been appreciated. Likewise, the advantages of score cards for dairy products are recognized.[2, 4]

Purpose. The score card furnishes a definite systematic means of arriving at a concise value of the product being scored. It is divided into component parts; each part has a numerical value. The score card shows the comparative importance of the different items that should be taken into consideration. The use of the score card enables the amateur judge to establish accurate judging habits by following a definite, orderly routine, thus re-

quiring a minimum of time and effort to accomplish a definite result. Score cards that contain a list of criticisms under each item are very helpful in pointing out the possible defects that may be found in the product.

The score card in itself is usually of little value as an aid in actual scoring to the experienced judge. He has developed and mastered the proper habits and correct procedure in the mechanics of scoring and evaluation of factors. However, the score card does serve him with a means of keeping an accurate, detailed record of the different samples that he has inspected. This also enables him to work in detail a greater number of samples at one time. Thus, it is evident that the use of a score card has many advantages, namely, (a.) educational; (b.) formation of correct judging habits; (c.) elimination of errors; (d.) saving of time; (e.) furnishing a permanent record, and (f.) serving as a guide to the improvement of quality.

Make-up or contents. With the advancement of judging, the score cards have approached uniformity. Near the top center appears the name of the product. To one side there is a blank space for the number or name of the contestant or judge. Below this, listed down the left side, usually in order of decreasing numerical importance, are the different items or factors to be considered in scoring the product. Directly opposite the items for consideration are placed the relative value of each item. The sum of these values, as previously mentioned, is 100 or a perfect score which, incidentally, is only theoretical and never given to any product. Adjacent to the column of numerical values is a blank column in which the actual evaluations of the items are to be written. Space is also generally allowed to check criticisms or for the judge to write in his comments. The use of different colored score cards for each dairy product aids materially in sorting the cards when several different products are scored in a judging contest.

Score cards used. There are score cards for nearly all the principal dairy products. Obviously, one standard score card cannot be made up satisfactorily for scoring all of the various dairy products since each product differs very materially in its characteristics. An exhibit of each score card will be found in the chapter dealing with that particular product.

Some differences are often noted in the form or arrangement of the score card, depending upon the use made of it. However, the basic points of consideration and their relative importance remain unaltered. The score cards presented in this text are in the main the ones formulated and approved by the American Dairy Science Association and are in general use throughout the United States. They are used in class work in dairy schools and in the Students' Collegiate International Contest in the Judging of Dairy Products which is supervised by the United States Department of Agriculture.

Use of the score card as a record. Since the score card is to be retained as a permanent record of the score of the product, erasures, strike-outs and untidy score cards should be eliminated by thinking through the process of judging and arriving at a definite conclusion before recording any scores. Erasures and strike-outs reveal uncertainty and lack of confidence on the part of the judge. Unfortunately, one addicted to changing his decision indiscriminately in scoring dairy products never enjoys the inward satisfaction of believing that this judgment is correct. Such practice leads to an inferiority complex, which in itself, handicaps the beginner from concentrating his thought, a very necessary faculty in the discovery of the elusive, delicate flavors and aromas present in the samples being judged.

Marking up the score. In marking up the score of a product, the general practice followed is to write down the points allowed rather than the deductions made. This method is both convenient and desirable. Mental calculations should be made previously and only the result marked on the score card. By following this practice, associations are soon formed between the flavor, the flavor score and the final total score.

Writing down criticisms. Although the practice of not criticizing a sample when the score is above a certain point is followed by most of the experienced judges, the training which comes from deciding definitely on the merits of an item and writing it down is very valuable to the beginner. One who evades a definite decision and avoids specifically designating the characteristic flavor whether the flavor is excellent, medium, or poor, develops slowly in judging proficiency. Thus, in using the score card effectively, writing down or checking criticisms is very important.

General method of using the score card. Details concerning the use of the various score cards are discussed in the chapters on judging and grading the different products. General statements regarding the use of the score card, however, may be made. No dairy products are given a perfect score even by an experienced judge. Deductions are always made on some item. Flavor, for example, is never allowed the perfect score. If flavor were scored perfect, then the acme of quality would have been attained and should a more desirable flavor be found it would be necessary to devise a new score card.

The smallest deduction generally made on any one item is one-half point. In case of high scoring samples in keen competition differences in flavor scores are sometimes made in one-quarter points. On the other hand, in scoring sediment of milk, one-tenth points are used under some conditions. The maximum deduction made depends entirely upon the item considered, which varies with the different products. There are no percentage ratings that might serve as a guide. Items which deal with body and texture, color, package and salt in butter are generally given full rating. Even the most serious defects in these items, which often deserve a maximum deduction, are of insufficient importance to warrant a deduction of more than 20 percent of the total value of the item. Improved processing and workmanship have accounted for a diminishing occurrence of defects in these items. Furthermore, some tolerance must be made for regional characteristics and preferences.

Use of the official score. To get the most good from the use of the score card the beginner must keep in mind that experience has always been and will continue to be a great teacher and that he must use every opportunity to profit thereby. For example, after definitely deciding on the flavor, and having arrived at a final score for the several samples judged, the beginner should compare intelligently his results with those of the experienced judge, noting particularly the flavors and his evaluation of them. If the judge gives his results orally, the beginner should record these findings on his own score card and later, when opportunity presents itself, re-score the samples and try to get the flavor reported by the judge. He should work with this flavor long enough to get a lasting impression of it. Furthermore, he should associate this flavor with the score allowed on that item, bearing

in mind, however, that the score allowed for that particular flavor will often vary somewhat from that given by the judge because of a variation in its intensity.

Satisfactory scoring. The beginner will discover early in his work that even the best judges themselves will sometimes disagree as to the final score of the product judged. This, however, is no cause for alarm or discouragement. The fact remains that experienced judges score sample after sample, placing on them scores remarkably close to each other. The flavors noted are more often in perfect agreement, yet the evaluations of these flavors differ slightly, depending on their relative importance, as viewed by the judge, and the intensity or volume of flavor. As long as mental processes, abilities of perception, keenness of the senses of smell and taste, and evaluation of sensed flavors differ with individuals, then there may be expected a variation in some scores of a number of samples of dairy products. Identical scores of a number of samples with those of the experienced judge are co-incidental. Scores of individual samples identical with those of the judge, however, are very common.

When a group of 10 or more samples of a product is scored (ice cream, for example), excellent scoring is done if the sum of the differences between the beginner's and official judge's score does not exceed an average of one point per sample. On butter judging even a narrower difference may be expected. To the beginner, this closeness of scoring may seem impossible but as he develops in his judging proficiency, such close agreement between judges will not seem unusual.

Dairy products grading outlines. In routine examination of dairy products, special forms on which to record the findings are employed. These report cards differ according to the product examined and according to the processing plant in which they are used. In general, these outlines have provision for recording information on the various items which appear on the score card, but make no provision for recording numerical scores. In addition, space is often provided for recording further information which is not called for on the score card, regarding the quality of the sample. For example, in the examination of packaged ice cream, space may be provided for recording the net weight of the sample, distribution of fruit or nuts, or the condition of the package. The items on the product examination, or grading outlines,

are usually those about which the consumer would be most concerned in purchasing a safe, high-quality dairy product. Ample room is available on these cards for grading all the several varieties or grades of a particular product sold. Such outlines have great utility value in dairy product quality control work.

References

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[2] Mojonnier, T. and Troy, H. C. 1925. *The Technical Control of Dairy Products.* Chicago: Mojonnier Bros. Co. xxviii+936 pp., Chapt. XX. Score cards for the dairy industry, pp. 794-831.

[3] Ross, H. E. 1939. *The Care and Handling of Milk.* New York: Orange Judd Publishing Company. xv+417 pp., Chapt. XIII. The inspection of milk in the country and the dairy score card, pp. 230-263.

[4] Van Slyke, L. L. and Price, W .V. 1938. *Cheese.* New York: Orange Judd Publishing Company. viii+358 pp., pp. 230-231.

Review Questions

1. What is a score card?
2. Why are "abridged" score cards sometimes used?
3. List the six advantages of using a score card.
4. What organization formulates and approves the dairy products score cards?
5. Why cannot one score card be formulated which would be suitable for scoring all dairy products?
6. What do erasures and strike-outs on a score card indicate?
7. What value is to be gained by criticizing or describing every sample judged whether the sample is "above criticism" or not?
8. Why are dairy products never given a perfect score by the judge?
9. In making deductions for the various items on the score card, when would you make a deduction of one-half, one-quarter and one-tenth points?
10. Why and how should the beginner make use of the official scores?
11. Why may variations within limits in scores of dairy products as made by proficient judges be expected to occur?

CHAPTER V

JUDGING AND GRADING MILK

The judging of market milk, both bulk and bottled, is of utmost importance to the market milk industry. The sale of bottled fresh milk comprises a major enterprise of the dairy industry. Since milk is consumed in the liquid state by all ages and by all classes of people, the product is being judged daily by the consumer. Naturally if the flavor is not appealing or appetizing, less milk will be consumed. Furthermore, an off-flavored milk may cast an unfavorable reflection on other dairy products sold by the milk plant and hence affect their sales.

The quality of dairy products is very dependent on the quality of milk used to make them. Defects in the finished dairy products, which jeopardize their sale, might be largely eliminated if the manufacturer could evaluate the quality of the raw material used. It is generally conceded among dairy product judges that the scoring or dividing of milk into different quality classes, known as grading, demands keener, more fully developed senses of smell and taste than does the scoring of any other dairy product. The flavors often present in milk are more delicate, volatile and elusive than those which the beginner is likely to experience in the judging of other dairy products.

Since milk is the basic material from which dairy products are made, it behooves every milk producer, milk distributor and processor of dairy products to learn how the different milk flavor defects affect the quality of the manufactured products. For good results, the milk processor should have the ability to detect flavors in milk and be able to compare them intelligently with the flavor of the manufactured products.

CLASSES OF MILK

Milk may be divided into two general classes, namely, *household or market milk* and *manufacturing milk.*

Household or market milk. Market milk is whole milk consumed in the fluid state. It is processed, packaged and distrib-

uted to the housewife, restaurant or hotel where it is used for drinking or culinary purposes. This milk reaches the consumer in the natural fluid state as contrasted to that milk which is converted into ice cream, concentrated milk, or other dairy products.

Market milk is generally produced under supervised conditions and used primarily for consumption as whole milk or separated to produce table or whipping cream. This class of milk may be grouped further with respect to its heat treatment previous to being placed on the market, namely, as raw or pasteurized milk. Both raw and pasteurized milk are subject to flavors that are essentially characteristic of each group. In the experience of the writers, however, there is little difference between the flavor of clean, raw milk and the same milk properly pasteurized. The writers believe, despite opinions to the contrary, that the majority of people cannot distinguish between high quality raw milk and the same milk when it is properly pasteurized.

Manufacturing milk. Manufacturing milk is generally bought in bulk in the raw state for processing into the various dairy products. This milk may be purchased according to grade, which will be discussed later in this chapter.

GRADES OF BOTTLED MILK

Within the class of market milk are many grades of milk. These grades are based chiefly on bacteriological quality and supervision of production and may vary to some extent in the various sections of the country.

The United States Public Health Service (1939) defines milk as follows:

> "The lacteal secretion obtained by the complete milking of one or more healthy cows, excluding that obtained within 15 days before and 5 days after calving, or such longer period as may be necessary to render the milk practically colostrum free; which contains not less than 8 percent of milk solids not fat, and not less than 3.25 percent of milk fat."

In addition, it describes in detail the several grades of milk and specifies the sanitary conditions under which the milk must be produced. For comparison, convenience and clarity, the most important requisites of these grades are presented in table 2.

Table 2 — Some Distinguishing Characteristics of the Various Grades of Milk as Specified by the United States Public Health Service Milk Ordinance and Code

Grade	Maximum plate count per ml. (log average)	Maximum direct microscopic count per ml. (log average) Clumps	Individual organisms	Maximum reduction (hours)	Some specified conditions of production other than bacteria standard
			To Be Consumed Raw		
Certified	10,000				Requirements of the American Association of Medical Milk Commissions.
A	50,000	50,000	200,000	8	Produced on inspected farms, tuberculosis and Bang's disease tested.
B	1,000,000	1,000,000	4,000,000	3½	Farm inspection same as for A grade but abortion testing requirements not fully met.
C	No standard	No standard	No standard	No standard	Milk which violates any of the requirements for grade B milk.
			To Be Pasteurized		
A	200,000	200,000	800,000	6	The raw milk must meet the requirements of grade A to be pasteurized.
B	1,000,000	1,000,000	4,000,000	3½	
C	No standard	No standard	No standard	No standard	
			Pasteurized		
Certified	10,000	......	......	......	Certified raw milk pasteurized according to requirement for grade A pasteurized milk.
A	30,000	......	......	......	Pouring lip covered to at least its largest diameter.
B	50,000	......	......	......	Lip-cover caps may not be used.
C	No limit	......	......	......	

The United States Public Health Service Standard Milk Ordinance standards for grades of milk are as follows:

1. *Certified milk-raw.* "Certified milk-raw is raw milk which conforms with the requirements of the American Association of Medical Milk Commissions in force at the time of production and is produced under the supervision of a medical milk commission and of the State board of health or of the city or county health officer of . . . "
2. *Grade A raw milk.* "Grade A raw milk is raw milk the average bacterial plate count of which as determined under sections . . . of this ordinance does not exceed 50,000 per cubic centimeter, or the average direct microscopic count of which does not exceed 50,000 per cubic centimeter if clumps are counted or 200,000 per cubic centimeter if individual organisms are counted, or the average reduction time of which is not less than 8 hours; Provided, that if it is to be pasteurized the corresponding limits shall be 200,000 per cubic centimeter, 200,000 per cubic centimeter, 800,000 per cubic centimeter, and 6 hours, respectively; and which is produced upon dairy farms conforming with all of the following items of sanitation." (26 items are presented.)
3. *Grade B raw milk.* "Grade B raw milk is raw milk which violates the bacterial standard and/or the abortion testing requirements for grade A raw milk, but which conforms with all other requirements for grade A raw milk, and has an average bacterial plate count not exceeding 1,000,000 per cubic centimeter, or an average direct microscopic count not exceeding 1,000,000 per cubic centimeter if clumps are counted or 4,000,000 per cubic centimeter if individual organisms are counted, or an average reduction time of not less than 3½ hours. . . ."
4. *Grade C raw milk.* "Grade C raw milk is raw milk which violates any of the requirements for grade B raw milk."
5. *Certified milk-pasteurized.* "Certified milk-pasteurized is certified milk-raw which has been pasteurized, cooled, and bottled in a milk plant conforming with the requirements for grade A pasteurized milk."
6. *Grade A pasteurized milk.* "Grade A pasteurized milk is grade A raw milk, with such exceptions as are indicated if the milk is to be pasteurized, which has been pasteurized, cooled and bottled in a milk plant conforming with all of the following items of sanitation and the average bacterial plate count of which at no time after pasteurization and until delivery exceeds 30,000 per cubic centimeter, as determined under sections . . . ." (23 items are presented.)
7. *Grade B pasteurized milk.* "Grade B pasteurized milk is pasteurized milk which violates the bacterial standard for

grade A pasteurized milk and/or the provision of lip-cover caps . . . and/or the requirement that grade A raw milk be used, but which conforms with all other requirements for grade A pasteurized milk, has been made from raw milk of not less than grade B quality, and has an average bacterial plate count after pasteurization and before delivery not exceeding 50,000 per cubic centimeter . . . ."

8. *Grade C pasteurized milk.* "Grade C pasteurized milk is pasteurized milk which violates any of the requirements for grade B pasteurized milk."

KINDS OF MARKET MILK AND SOME QUALITY CHARACTERISTICS SPECIFIC TO THEM

1. Pasteurized milk. Pasteurized milk is milk which has been subjected to pasteurization temperatures for a prescribed period of time. In general, two time-temperature relationships are recognized for pasteurizing milk in the United States. These are 142° to 143° F. (61.1 to 61.8° C.) for 30 minutes, known as the holding process, and 160° to 161° F. (71.1 to 71.8° C.) for 15 seconds, known as the high-temperature short-time process. Equipment by which milk is pasteurized varies widely in design but the results obtained are essentially the same. As previously mentioned, the flavor of milk is not impaired by proper pasteurization to the extent that one may distinguish with certainty between a good flavored raw milk and the same milk properly pasteurized. However, pasteurized milk is subject to certain flavor defects not commonly encountered in the raw product. A list of them will include such flavors as "heated," "cooked" and "oxidized." The oxidized flavor will likely be more pronounced in winter than in summer. These flavors will be adequately described later in this chapter. The bitter, soapy, rancid flavor often encountered in raw milk, resulting from the hydrolysis of some of the milk fats, is never found in properly pasteurized milk.

When milk is first pasteurized it may have a definitely heated flavor, erroneously called cooked flavor, which upon storage will lessen in intensity and may disappear entirely. Particularly is this true if copper is present as pointed out by Gould (1940). The amateur judge should know that the flavor of pasteurized non-homogenized milk has a tendency to change in flavor upon storage as follows: Heated ——>normal ——>flat ——>metallic ——>oxidized. The extent of this change will

depend upon time of storage, season of the year and the presence of copper. A knowledge of the method of pasteurization may be of some value in studying the flavor of pasteurized milk.

Studies by MacCurdy and Trout (1940) showed that high-temperature short-time pasteurization resulted in higher percentages of the samples having an excellent flavor with greater stability of flavor upon storage than when the milk was pasteurized by the holding method.

2. *Certified milk.* Certified milk is produced under strict sanitary conditions and, whether raw or pasteurized, must have a bacteria plate count under 10,000 per ml. Thus, the group of bacteria-produced flavors will not be present. Rancidity is possible in the raw product but not in the pasteurized. Since the milk is relatively low in bacteria the biological oxygen demand is so low that an abundance of oxygen is available for chemical activity. Thus, if the milk is susceptible to oxidation or comes in contact with copper it is very liable to develop an oxidized flavor, particularly in the pasteurized product during the late winter months. The fact that certified milk may be low in bacteria does not assure freedom from flavor defects.

3. *Special breed milk.* Special breed milk as the name indicates, is high quality milk of a particular breed produced under rules prescribed by the breed association involved. The chief special breed milks are:

a. GOLDEN GUERNSEY MILK. This is a trade name for high quality Guernsey milk produced according to the regulations of the American Guernsey Cattle Club.

b. JERSEY CREAMLINE MILK. This is a trade name for high quality Jersey milk produced under the regulations of the American Jersey Cattle Club. Conditions of production are comparable to those which exist in the production of Golden Guernsey milk.

Special breed milk when bottled on the farm where produced is generally hood-capped and usually is sold raw. As such, the milk is subject to flavors specific to raw milk, chief of which from the standpoint of occurrence is the feed flavor. However, rancidity is probably the most troublesome flavor defect encountered.

4. *Vitamin D Milk.* Vitamin D milk is milk the vitamin D content of which has been increased above that of normal milk

by special processes in accordance with public health regulations. Three general processes employed in producing vitamin D milk are:

a. By feeding irradiated yeast. Irradiated yeast is fed to cows according to production. Such milk is known as metabolized vitamin D milk. The process is best suited to the producer-distributor who desires to market a vitamin D milk. This process is not associated with any particular off-flavors different from those which may be normal to raw milk.

b. By irradiation. In this method of producing vitamin D milk, the milk, in thin, flowing films, is exposed to ultra-violet radiations from a carbon-arc or a quartz-mercury-vapor lamp. No perceptible flavor develops in the process when it is properly done. However, over irradiation may result in a peculiar burnt taste resembling that developing in milk exposed to the sun. Weckel and Jackson (1939) describe the flavor resulting from incorrect radiation as follows: "The flavor in its incipient stage may best be described as 'flat,' and in advanced stages of development as 'burnt,' 'burnt feather' or 'burnt protein.' The flavor is also sometimes characteristic of that observed in mushroom soups or broths, and may thus be described as a mushroom flavor. The activated flavor is to be definitely distinguished from other flavors, such as tallowy, oxidized or cardboard flavors. A distinguishing characteristic of the activated flavor is that it may become more noticeable when the milk is heated to 82.2° C. or higher and subsequently cooled."

Flake, Jackson and Weckel (1938) showed that this flavor defect in irradiated milk might be overcome by adding two to three parts per million of copper to the irradiated milk followed by bubbling air through it. Thus, it would appear that if the irradiated milk having a burnt flavor were copper contaminated the burnt flavor would gradually decrease in intensity. The amateur judge should be familiar with this possibility of flavor change.

c. By addition of a vitamin D concentrate. Several vitamin D concentrates are available for addition to milk for the purpose of increasing its vitamin D potency. In

some cases homogenization is a part of the process of incorporation. The concentrate itself does not impair the flavor of the milk. However, if the milk is homogenized the vitamin D milk will be more susceptible to the activated sunshine flavor resembling burnt protein and less susceptible to the cardboard, oxidized flavor. This fact should be recognized by the judge as a possible clue when tracing the cause of flavor defects in vitamin D milk.

5. *Vitamin-fortified milk.* Vitamin-fortified milk, sold under specific trade names, contains a variety of vitamins, as A, B_1, B_2, C, D, nicotinic acid and calcium pantothenate, in quantities per pint to meet adult requirements. The milk is pasteurized and homogenized. Any flavor defects of the milk will likely be those characteristic of pasteurized or homogenized milk. However, such milk should never exhibit an oxidized flavor because the milk not only is homogenized, which inhibits oxidation for all practical purposes, but also contains vitamin C in quantities to stabilize the flavor against oxidation.

6. *Homogenized milk.* Homogenized milk is milk the fat globules of which have been so finely divided that they remain uniformly dispersed throughout the serum. The milk should remain practically homogeneous so far as the fat is concerned, as pointed out in the United States Public Health Service Milk Ordinance and Code definition for the product which is as follows:

> "Homogenized milk is milk which has been treated in such a manner as to insure break-up of the fat globules to such an extent that after 48 hours storage no visible cream separation occurs on the milk and the fat percentage of the top 100 cc. of milk in a quart bottle, or of proportionate volumes in containers of other sizes, does not differ by more than ten percent of itself from the fat percentage of the remaining milk as determined after thorough mixing."

In judging homogenized milk the judge must be aware of the possible occurrence of some defects to which homogenized milk is susceptible and of the freedom from other defects which may be common to raw milk. These are described briefly under the following headings:

a. Flavor. Homogenized milk has three possible flavor characteristics which differ from non-homogenized milk. First, if the milk is homogenized while raw before the lipase

is destroyed, or if not pasteurized immediately after homogenization, or if contaminated with raw milk, rancidity quickly develops. Such milk is distinctly rancid a few hours after processing and becomes bitter and soapy within 24 hours when stored at a low temperature. Dorner and Widmer (1931) and Halloran and Trout (1932), working independently showed that all cows' milk is subject to the development of rancidity upon homogenization unless adequately heat treated to inactivate the enzyme lipase. Doan (1933) found that the critical temperature for inhibiting the development of rancidity in homogenized milk was 147° F. (63.9° C.) for flash heating. Furthermore, it must be emphasized that raw milk may not be mixed with homogenized milk, or rancidity will likewise develop. Therefore, if the judge encounters a rancid flavor in homogenized milk he may be assured that all the product was not adequately heat treated.

Second, homogenized milk is less susceptible to the development of the copper-induced cardboard or oxidized flavor. As pointed out by Tracy, et al. (1933) and later substantiated by others, if the product is properly pasteurized, well refrigerated, and not unduly exposed to light, the good, rich flavor of homogenized milk will remain fixed and stable for a considerable period beyond that at which non-homogenized pasteurized milk might become old and stale.

Third, homogenized milk is more susceptible to the development of the activated or sunshine flavor when exposed to light than non-homogenized milk as pointed out by Hood and White (1934). This flavor has a burnt protein character and should not be confused with the papery taste sensation of the true copper-induced oxidized flavor.

b. Sedimentation. In the absence of fat rising in homogenized milk any destabilized protein, colloidal dirt, or yeast and body cells present, readily settle out to yield a yellowish or smoky appearing layer in the bottom of the bottle. When the bottle is agitated slightly, or the milk is heat shocked, this deposit may clump into feathery, wooly, or oily appearing masses resembling dirt or oil. The milk judge should be familiar not only with the possibility of sedimentation in homogenized milk, but also with its char-

acteristic behavior upon handling. He should ascertain, too, whether the milk had been clarified. If the freshly bottled homogenized milk is judged after six or eight hours following proper refrigeration where heat shocking or agitation has not occurred, sediment may not be noted, whereas the same milk judged after 24 hours and after handling might show considerable sediment.

c. *Leaky closures.* Difficulty is sometimes encountered with seepage of bottled homogenized milk particularly during the summer which is not so frequently noted in bottled non-homogenized milk (Trout, 1942). The judge should be familiar with this characteristic of homogenized milk and be on the alert for the defect when judging this product.

d. *Watery appearance.* If homogenized milk is allowed to freeze and then be defrosted slowly, the upper portion appears watery due to the settling out of some of the milk solids including the fat (Hood and White, 1934, and Trout, 1940, 1941). The milk judge should be familiar with the behavior of homogenized milk under this condition so that the milk will not be unduly criticized, as having been watered.

e. *Cream layer or cream plug.* If homogenized milk is inadequately processed, heat shocked, agitated unduly, or held for an extended period at room temperature it may show a cream layer. This is not desirable.

7. *Soft-curd milk.* A soft-curd milk has a curd tension not exceeding 30 grams as determined by the Hill method. This type of milk may be secured by one of several ways, namely, by

a. Selecting cows yielding a natural soft-curd milk.
b. High heat treatment.
c. Homogenization, including high frequency vibration.
d. Zeolite treatment (base-exchange).
e. Proteolytic enzyme treatment.
f. Acidification.
g. Addition of sodium salts of complex phosphates.
h. Dilution.

In judging the organoleptic qualities of a soft-curd milk one should ascertain the method by which the low tension milk was obtained. The milk may or may not have, or be subject to, flavor

changes depending upon the type of soft-curd milk. If the milk has a natural soft curd, as from individual cows, the possible off-flavors would be those common to raw milk. The judge should be particularly alert to a salty flavor.

High heat treated milk has a distinctly "cooked," "boiled" or "mushroom" flavor. Boiled milk yields the cooked taste. In fact, Gould and Sommer (1939) showed that the cooked taste was produced when the milk was heated momentarily to 76° to 78° C. (168.8° to 172.4° F.) or at 70° to 72° C. (158° to 161.6° F.) for 30 minutes. Usually temperatures higher than these values are required for producing a soft-curd milk by heat treatment. Evaporated milk, usually sterilized at about 240° F. (121.1° C.) for 15 minutes, has extremely low curd tension and a flavor somewhat resembling that of mushroom soup.

Soft-curd milk produced by homogenization may or may not have a cooked flavor depending upon the temperature treatment accompanying the process. If the temperature treatment is below that yielding the cooked flavor then the product will likely have only the flavors associated with homogenized milk as previously described.

In the experience of the writers the zeolite-treated milk has a taste slightly different from that of normal milk, being somewhat flat. However, Sommer (1946) states, "The flavor of the milk is practically unaltered by the zeolite treatment; a few consumers detect a slight change suggesting softened water."

Sommer (1939) found that no change was evident in the flavor of soft-curd milk produced by enzyme treatment.

Flavor changes in milk rendered soft by dilution, by acidification or by addition of sodium salts of polyphosphates may be anticipated. These types of soft-curd milk are not widely distributed commercially and, therefore, the milk judge will have little occasion to judge them.

8. Reconstituted milk. Reconstituted milk is the product resulting from the recombining of milk fat and nonfat dry milk solids or dried whole milk with water in proportions to yield the constituent percentages occurring in normal milk. For this purpose various forms of milk fat such as butter, butter oil, fresh or frozen cream and nonfat dry milk solids, dried whole milk, or concentrated milks may be used. The product is practically always homogenized. Despite the fact that homogenization, a

part of the process, inhibits the development of the oxidized flavor in milk, the oxidized flavor in greater or lesser intensity may be present due to the fact that the flavor might have developed in some of the products prior to their use. Two other types of flavors may be associated with reconstituted milk, namely, flat and heated or cooked which may be easily detected.

THE MARKET MILK SCORE CARD

The market milk score card approved by the American Dairy Science Association in 1941 is shown in Figures 8 and 8a. A glance at this score card will reveal that like the butter, cheese, and ice cream score cards the sum of the items totals 100 points. The value given flavor is 45 points, the same as that for the other dairy products mentioned, because flavor is considered to be the most important item. Regardless of the importance of a low bacterial count, freedom from sediment, and the sanitary features of the container and closure, milk must have a good flavor to merit continued acceptance by the consumer.

The beginner should study the market milk score card carefully, noting the items on it and their values and the specific directions for scoring. Here it should be pointed out that the scoring of bacteria and temperature are routine laboratory procedures and the scoring of these items becomes entirely mechanical. On the other hand the scoring of flavor, sediment and container and closure require much practice and experience if proficiency in judging milk is to be attained.

In judging contests where laboratory facilities and time do not permit a complete scoring, the milk samples are scored according to the abridged score card shown below.

Abridged Milk Score Card Used in Scoring Contests

Item	Perfect score
Flavor	45
Sediment	10
Container and closure	5
Total	60

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF DAIRY INDUSTRY

SCORE CARD FOR MILK AND CREAM
(Approved By The American Dairy Science Association)

Place . . . .

Class . . . . *Exhibit No.* . . . .

	Perfect Score	Score Allowed	Remarks
Flavor and odor	45	. . . .	"Flavor defects" listed on other side . . . .
Bacteria	35	. . . .	Bacteria found per milliliter . . . .
Sediment	10	. . . .	. . . .
Temperature	5	. . . .	Degrees . . . .
Container and closure	5	. . . .	Container . . . . Closure . . . .
Total	100	. . . .	

Exhibitor . . . .

Address . . . .

(*Signed*) . . . .

. . . .

. . . .

Judges.

Date . . . .

B. D. I-64
(Rev. 1941)

16—24004-1

Figure 8.
U. S. Department of Agriculture Score Card for Milk and Cream (front)

DIRECTIONS FOR SCORING

FLAVOR AND ODOR — PERFECT SCORE, 45

Deductions for disagreeable or foreign odor or flavor should be made according to conditions found. When possible to recognize the cause, it should be described under "Remarks." The following may be used as a guide in scoring flavor:

Excellent:	40 and above; no criticism.
Good:	37 to 40; lacking special high flavor, flat, very slight feed, slight cooked.
Fair:	34 to 37; cooked, feed, salty, slight cowy, slight oxidized.
Poor:	25 to 34; strong feed, weedy, bitter, strong, musty, cowy, oxidized, very slight rancid.
Bad:	25 and below; rancid, strong cowy, high acid. 0; sour, putrid, or any flavor sufficiently strong to render the milk unfit for market purposes.

BACTERIA PER MILLILITER — PERFECT SCORE, 35

	Points		Points		Points
500 and under...	35.0	11,100–12,000.....	32.7	36,000– 40,000....	25.6
510– 1,000.......	34.9	12,100–13,000.....	32.5	41,000– 45,000....	24.1
1,010– 1,500.......	34.8	13,100–14,000.....	32.3	46,000– 50,000....	22.6
1,510– 2,000.......	34.7	14,100–15,000.....	32.1	51,000– 55,000....	20.6
2,010– 2,500.......	34.6	15,100–16,000.....	31.9	56,000– 60,000....	18.6
2,510– 3,000.......	34.5	16,100–17,000.....	31.7	61,000– 65,000....	16.6
3,100– 3,500.......	34.4	17,100–18,000.....	31.5	66,000– 70,000....	14.6
3,600– 4,000.......	34.3	18,100–19,000.....	31.3	71,000– 75,000....	12.6
4,100– 4,500.......	34.2	19,100–20,000.....	31.1	76,000– 80,000....	10.6
4,600– 5,000.......	34.1	20,100–21,000.....	30.9	81,000– 85,000....	8.6
5,100– 6,000.......	33.9	21,100–22,000.....	30.7	86,000– 90,000....	6.6
6,100– 7,000.......	33.7	22,100–23,000.....	30.5	91,000– 95,000....	4.6
7,100– 8,000.......	33.5	23,100–24,000.....	30.3	96,000–100,000....	2.6
8,100– 9,000.......	33.3	24,100–25,000.....	30.1	Over 100,000.....	0
9,100–10,000.......	33.1	25,100–30,000.....	28.6		
10,100–11,000.......	32.9	31,000–35,000.....	27.1		

SEDIMENT — PERFECT SCORE, 10

Examination for sediment shall be made by means of a sediment tester, and the resulting cotton discs compared with standards. When possible, the nature of the sediment should be described under "Remarks."

TEMPERATURE — PERFECT SCORE, 5

	Points		Points
50 degrees F. and below..........	5	57 to 60 degrees..................	1
51 to 53 degrees..................	4	Above 60 degrees................	0
54 to 56 degrees..................	3		

CONTAINER AND CLOSURE — PERFECT SCORE, 5

Make deductions in score for dirty, leaky, dented, or chipped containers; and for closures which do not cover the lips of the containers or do not fit properly in the closure seats.

Note – Any sample failing to comply with the legal standard for bacteria, fat, solids not fat, or total solids shall be debarred from competition.

Figure 8a.

U. S. Department of Agriculture Score Card for Milk and Cream (back)

SOME MARKET MILK SCORING TECHNIQUES

Preparation of samples for judging. The preparation of bottled milk for judging will depend largely upon the kind of judging to be done and hence the number of judges participating in the scoring. For example, if a number of persons are to score the samples as in a students' judging contest, separate bottles of each individual lot of milk must be provided for the complete examination of the bottle and closure. In addition prepared sediment discs of each lot of milk mounted on a card or enclosed in a covered petri dish should be available. By these provisions each judge may score the bottle and closure and the sediment with the assurance that the samples are representative of the lot. Both the bottle and the sediment disc should be labeled securely and correspondingly for identification. The sediment disc is generally placed directly in front of the bottle. The milk sample should be marked in such a manner that it is easily distinguished and the identification fastened to the bottle in such a manner that it is somewhat permanent. A small paper tag fastened to the bottle with a rubber band has proven very satisfactory. The tag and the tie should be odorless.

In routine scoring of bottled milk in a milk plant, where only two or three judges go over the samples in unison, the preparation of the samples as previously described seems unnecessary. However, systematic arrangement of the samples before actual scoring begins is an aid to proficiency. Neither tagging of the bottles nor preparation of sediment discs are required. Identification of the sample is made by means of the bottle closure, whereas the sediment rating may be determined by observing the bottom of the unshaken and undisturbed bottle.

Order of examination and scoring. A scoring routine which enables the beginner to make efficient use of his time and which develops concentration of thought should be followed. Furthermore, the routine should enable the inexperienced judge to make direct comparison between the different samples in respect to some of the items on the score card. In the case of student contestant judging, the name or identification of the contestant should be placed at the top of the score card before beginning. If not already indicated on the card, the numbers of the samples should be placed thereon consecutively. The order of examination should be as follows:

1. Sediment. Sediment scoring should be done first. The kind, the amount and the size of the sediment particles should be carefully observed. In scoring sediment discs, the first few scorings may be compared with standard charts which have been prepared and scored by experienced judges. The image of this chart should become a part of the beginners' mental equipment so that continued comparisons of sediment discs with actual charts will not be necessary.

2. Closure. After having scored the milk for sediment, the closure should be carefully observed and scored. The perfect bottle closure has three main functions, namely, (a) to hold the milk in the bottle, (b) to protect the pouring lip from contamination, and (c) to seal the bottle against tampering without detection. In order to fulfill protection requirements, the cap must cover the pouring lip at its greatest diameter. Observe whether the cap is properly seated so there is no leakage which may cause contamination. If the cap is covered, the covering should be tight, waterproof and tamperproof. It should be determined whether the cap was inserted by hand or by machine. Hand capping is generally prohibited by milk ordinances due to the danger of contaminating the milk by human contact. Thus, certain observations and judgments should be made relative to the closure itself; namely, whether it fully protects, partially protects, or does not protect the pouring lip; whether it is properly seated; whether it is leaky and (should the closure be covered), whether the covering is fastened securely and is made of waterproof material; and whether the closure seals the container.

3. Container. The bottle should be examined next for fullness, cleanliness, and freedom from cracks or chips, particularly about the pouring lip. Any condition of the bottle that may interfere with the safety and wholesomeness of the contents should be carefully observed. With practice, this observation may be made quickly and accurately.

4. Flavor. The scoring of milk for flavor is done only after the other items of sediment and container and closures have been considered. The temperature of the milk should be high enough at the time of scoring that any odor present may be detected readily from the bottle and yet sufficiently low that the temperature of the milk will rise appreciably when taken into the mouth.

A temperature of 60° to 70° F. (15.5° to 21° C.) has been found to be a satisfactory temperature range for scoring milk.

The judge should make certain that the milk is well mixed before sampling. However, before mixing the milk he should remove the cap and examine the under side for adhering cream or foam and the milk for a cream plug. Samples for scoring should be taken in clean drinking glasses, beakers, or paper drinking cups. For this purpose, 100 ml. pyrex beakers have proven very satisfactory. As soon as the sample is taken, take a generous sip of it, roll it about the mouth, note the flavor sensation, and then expectorate it. Sometimes the after-taste may be enhanced by drawing a breath of fresh air very slowly through the mouth, and then exhaling it slowly through the nose. Swallowing the milk as a means of detecting flavors is a poor practice. By placing the nose directly over the container immediately after the milk has been shaken, and taking a full "whiff" of the air, any off odor present may be noted. Agitation of the milk leaves a thin film of milk on the inner surface which tends to evaporate, thus readily giving off the odor present. Practice will enable the beginner to detect even the faintest odors in this way.

REQUIREMENTS OF HIGH GRADE MARKET MILK

Container and Closure — 5 points

The bottle should be neat and clean and contain the full volume of milk represented. The milk in the bottle should be protected from contamination by a well made, well seated, waterproof cap which protects the pouring lip at its largest diameter. The bottle itself should be bright, shiny, free from dirt, dust and ground glass areas as a result of case wear or caustic etching. The bottle should not be cracked or chipped, particularly on the pouring lip. A chipped lip often results in a leaky or poorly seated cap and is frequently a lodging place for dust and dirt. Chipped areas are liable to harbor microorganisms as such bottles are hard to clean due to their rough surfaces.

1. Fullness of the bottle. In discussing regulations on fullness of bottle, certain bottle nomenclature is involved. The bottle nomenclature used herein is that designated by Roland and Trebler (1938) and is shown in Figure 9.

State laws vary widely as to the legal fullness of the milk bottle. That the bottle should be full is without question. How-

ever, the tolerance of fillage is often the subject of considerable debate. Some bottles have a fill line indicated which is slightly below the cap seat. Obviously, the bottle is legally full when the milk is filled up to the designated volume line.

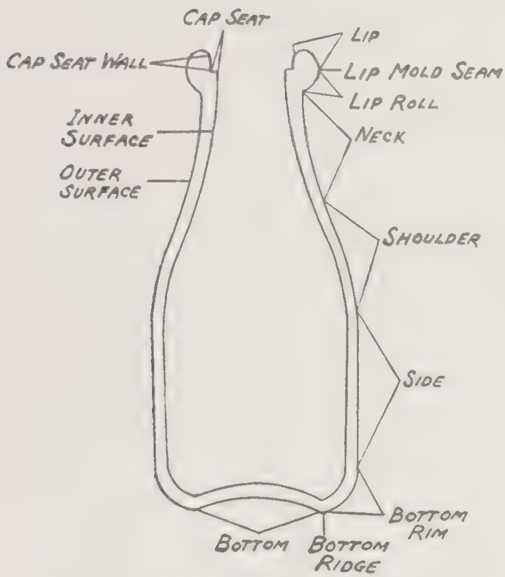

Figure 9 — Milk Bottle Nomenclature (Roland, C. T., and Trebler, H. A. A Plant Study of Damaged and Defective Milk Bottles. Jour. Dairy Sci. 21:275, 1938).

Trout (1942) studied the fillage of milk bottles in Michigan and reported in part as follows:

> "According to Michigan laws, a quart bottle used for the sale of milk and cream shall have a capacity of one quart filled full to the bottom of the lip. It may vary 4 drams above and four drams below on the individual quart bottle, but the average contents of not less than twenty-five bottles selected at random from at least four times the number tested must not be in error by more than one-quarter of the tolerance . . . one dram above and one dram below on the quart."
>
> "By actual measurement on three types of bottles tested by the Division of Weights and Measures of the Bureau of Foods and Standards, Michigan State Department of Agriculture, quart measures filled both the 56 mm. and the 48 mm. quart milk bottles to a point about midway from the cap seat to the base of the lip roll. This level of fill was approximately one-eighth inch from the cap seat on the 56 mm. bottle and one-sixteenth of an inch on the 48 mm. bottle."
>
> "Using the milliliter conversion factor, one dram, the average tolerance permitted, would be equivalent to 3.6967 ml., which volume approximates one-eighth of an inch below the cap seat of the standard 56 mm. bottle. On this

bottle the cap seat is approximately one-fourth of an inch above the bottom of the lip roll. This distance, approximately one-fourth inch, permits both a normal fill, one-eighth inch below the cap seat, and the tolerance, equivalent to about one-eighth inch, without the milk line showing below the base of the lip roll. Thus, considering the tolerance provided, a 56 mm. bottle would be recognized as full when it is filled to the base of the lip roll. Such consideration is generally accepted by the coaches of dairy products judging teams and by milk judges, using the milk score card of the American Dairy Science Association.

"A dram tolerance in the 48 mm. bottle represents a volume approximately three-sixteenths inch from the cap seat, which distance extends to a line slightly below the base of the lip roll. The lip roll on the 48 mm. bottle about one-eighth inch, does not provide sufficient space for normal fill, approximately one-sixteenth inch below the cap seat, and for the tolerance, approximately three-sixteenths of an inch, without showing the milk line below the base of the lip roll. Such a bottle although legally full would likely be criticized unjustly by the market milk judge as not being full."

From the above discussion, therefore, it appears that leniency should be shown in judging the fullness of the bottle particularly in case of the 48 mm. bottle in which the tolerance would throw the fill line below the level of the base of the lip roll.

2. *Bottle closures.* As previously stated the milk bottle closure has three functions, (a) to retain the milk within the bottle, (b) to protect the pouring lip from contamination and (c) to seal the bottle against tampering. The closure is judged on the completeness with which it fulfills these three functions. The cap is intended primarily to retain the milk within the bottle. In addition, the cap that meets the United States Public Health Service requirements for grade A milk protects the pouring lip of the bottle from contamination. More recently, emphasis is also being placed on the sealing desirability of bottle closures.

There are many different kinds of milk closures or caps on the market. They differ as to material, form, size and utility. In general, they may be grouped as full protective, partially protective, or nonprotective and as sealed or nonsealed. Full lip protection is considered to be attained when the bottle closure extends over the lip to the lip-mold seam, which is at its greatest diameter. The general grouping of closures is illustrated in

Figure 10 — Examples of Full Protective, Partially Protective, and Non-Protective Bottle Closures.

Figure 10. Full protective, partially protective and non-protective closures are given a rating of 5.0, 4.5, and 4.0 respectively

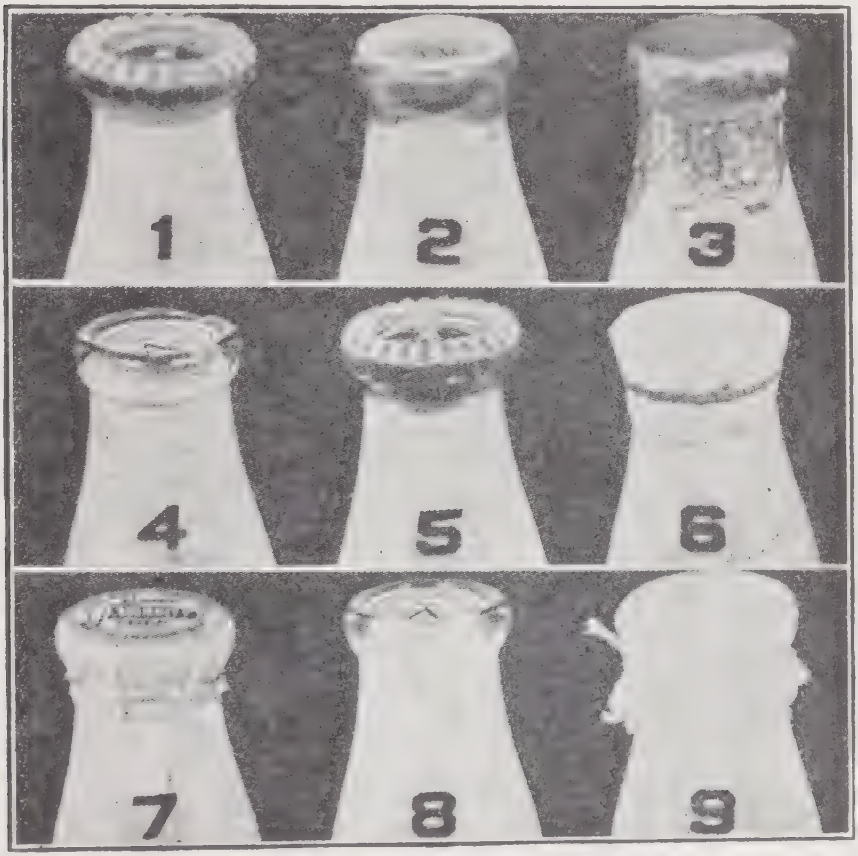

Figure 11 — Bottle and Cap Samples Prepared to Show Certain Faults. (From Neb. Agr. Exp. Sta. Cir. 54.)

Criticism	Score
1. Lip partially protected (0.25)	4.75
2. Lip partially protected (0.50). Not full (0.50)	4.00
3. Unsealed cap protector (0.25)	4.75
4. Lip not protected (1.0). Chipped lip (0.50)	3.50
5. Lip partially protected (0.25). Not full (0.25)	4.50
6. Absorbent cap cover (paper) (0.25). Unsealed cap protector (0.25)	4.50
7. None (perfect score)	5.00
8. Lip not protected	4.00
9. Absorbent cap cover (cheese cloth) (0.50). Unsealed cap protector (0.25)	4.25

on this feature alone. Deductions may be made further if unsealed or if other defects are present as shown in Table 3, and in Figures 11 and 12. The total deductions for bottle and closure may not exceed two points.

Table 3 — Usual Deductions on Container and Closure

Defect	Deductions
Container closure unsealed	.25
Container not full (milk line below lip roll)	.5
Container dirty on the inside	1.0
Container dented	.25
Container leaky	1.0
Closure poorly seated or leaky (if uncovered)	.5
Lip chipped	.25
Lip unprotected	1.0
Lip partly protected	.5
Lip cover not waterproof	.5
Torn closure cover (not waterproof)	.5

Sometimes the pouring lip of a bottle, closed with a nonprotective cap, is covered by a separate protective covering. This is known as double capping. Such a combination, if waterproof and not torn, fully meets the requirements for lip protection and is given a perfect score for that factor even though the cap under the cover may show seepage to a slight degree. A deduction is

Figure 12 — Left: Pouring Lip Chipped and Bottle Cracked. Left Center: Bottle Etched and Worn. Right Center: Dirty Bottle. Right: Bottle Not Full.

made for a cloth or absorbent cap covering. Various types of bottle closures are shown in Figures 13 and 14.

Since the chief function of the closure is to keep the milk within the bottle, special attention should be made to see how well it fulfills this function. Closures may show evidence of leaking around the edge or at the "pull-tab" depending upon the type and condition of the closure and whether the milk was homogenized (Figure 15). Homogenized milk, having no cream-

Figure 13—Various Types of Bottle Closures, Are They all Sealed?

layer seal, tends to seep out even with the best of closures, especially when the milk is warmed slightly. Evidence of thumb capping, bulged caps or inadequately seated caps should also be noted. Leaky or poorly seated closures merit a deduction of .5 point.

The question as to when or under what conditions a container closure is sealed is the subject of much discussion. Webster gives two definitions of the word "seal" used as a verb which seem to apply to this situation. These are: "To close by a seal, coating or other fastening that prevents access as, *sealed* up hermetically; to *seal* files for examination" and "to close

Figure 14 — Various Types of Bottle Closures. Which Are Sealed, if any? Which Protect the Pouring Lip? Place a Numerical Value on Each Closure.

securely, as a letter or jar with some viscous substance.'' Funk and Wagnalls define the noun ''seal'' in part as follows: ''A substance employed to secure a letter, door, lid, wrapper, joint, etc. to prevent its being opened, penetrated, or tampered with.'' Thus, it would appear that a container would be considered as being sealed if and when it became necessary to bend, break, open, or tear a seal to gain entrance to the milk whether the seal was cellophane, metal, paper, plastic, resin, rubber, or vacuum regardless of the possibility of replacing the closure without detection.

Generally, a sealed closure is considered to be a tamperproof closure. There may be some exceptions. Actually no bottle closure is tamperproof as tampering may be done with any of them. In milk judging, however, a ''tamperproof'' closure is recognized as one which cannot be removed and replaced without readily showing that it has been removed. Thus, the term ''sealed bottle closure'' and ''tamperproof bottle closure'' should be synonymous so far as judging the closure is concerned. For all

Figure 15 — Bottle Closures May Leak at the "Pull-Tab" or at the Edge Depending Upon the Type and Condition of the Closure.

practical purposes a sealed closure is considered to be one that cannot be removed and replaced without obvious detection.

3. *Judging single-service containers:* Single-service containers have become increasingly important in the distribution of bottled milk. The market milk judge must, therefore, be familiar with the kinds of single-service containers, the possible defects associated with them, and the comparative evaluation of the defects. Some single-service containers have sealed closures, and protected pouring lips; others have the simple so-called common sense cap, which neither protects the pouring lip nor is sealed (Figure 16). The container closure of the single-service container is subject to the same cuts for shortcomings as the multiple-service container. Items to look for particularly in judging single-service containers are: (a) distorted, or bulged package;

Figure 16 — Paper Containers Showing Various Types of Closures.

(b) soiled package; (c) dented package; (d) flaky or cracked paraffin; (e) absorbent fibre; (f) leaky container or closure, and (g) evidence of weakened package as a result of icing. Leniency must be shown in judging the fullness of the container because the package is never rigid as glass and any bulging, even though slight, causes the milk to recede slightly and results in what might appear to be a slack-filled bottle. Fullness may be determined by observing the opened container. Rarely will an off-flavor be noted in the milk as the result of contact with the paper container. Should the cardboard or papery flavor be noted, very likely this off-flavor is due, not to contact with paper, but to copper contamination during processing of the milk. Sediment may be judged only by making a sediment test of the milk.

4. Scoring container and closure. Although the container and closure is evaluated at only five points, there are several possible defects which must be considered in arriving at the final rating. For the guidance of the beginner, a list of defects and the deductions usually made are given in Table 3.

Obviously certain combinations of container and closure defects would reduce the total score for this item to a very low value. The judge must bear in mind, however, that the milk being scored is in a marketable package and as such should never be so serious as to possess all the major objections. The normal range in score for container and closure of commercial market milk is from 3 to 5 points. The scoring of containers and closures should present little difficulty to the beginner. By paying careful attention to details and close observation for all possible defects, good performance can be achieved with little practice.

Temperature — 5 points

The temperature at which market milk is held is very important to keeping quality and to the preservation of good flavor. Milk that is delivered at 50° F. (10° C.) or lower is given a perfect score of 5 points on this item. For each three degrees above 50° F. (10° C.) one point is deducted until the temperature of 60° F. (15.5° C.) is reached. Milk delivered at 60° F. (15.5° C.) or above is given a score of 0 on this item.

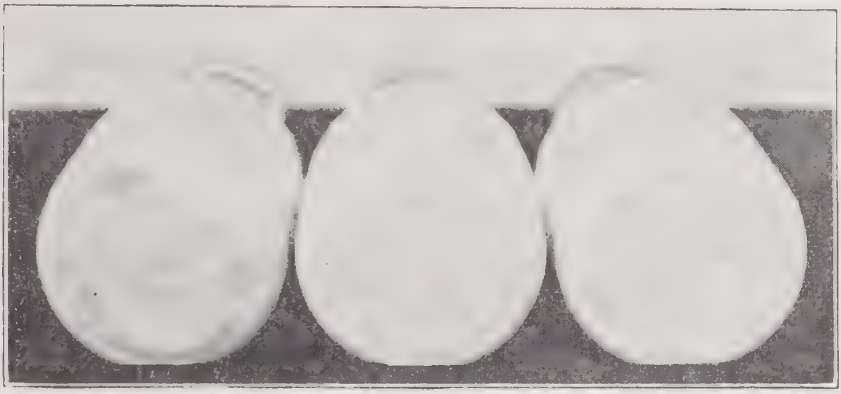

Figure 17 — Bottles of Homogenized Milk Showing Heavy Sediment.

Generally, the scoring of temperature is not done in student milk scoring contests, but is scored in a "surprise" or "pick up" milk contest. The object of this kind of contest, in part, is to educate milk distributors in the importance of delivering milk to the consumer that is properly cooled and refrigerated up to the time of delivery. In student milk scoring contests temperature is given a full rating of five points.

Sediment — 10 points

Milk can be scored for sediment either by observing the particles of sediment which may have settled to the bottom of the bottle or by observing the sediment collected on a cotton disc.

Figure 18 — Homogenized Milk (Right) Sometimes Shows a Dark Flocculent Precipitate Which Is Not Present in Non-Homogenized Milk (Left).

In either case, the comparisons should be made on the sediment in one pint of milk.

Judging sediment by carefully observing the sediment particles on the bottom of the bottle when held above the eyes is somewhat tedious, inaccurate, and presents difficulties. When a number of people are handling the same samples some of the sediment particles are liable to be remixed with the milk which

Figure 19 — Care Must Be Exercised in Examining Homogenized Milk for Sediment as the Sediment Readily Remixes With the Milk With Slight Agitation. Note That the Rim of the Sediment Ring Has Broken Away Due to the Slight Incline at Which the Bottle Is Held.

makes them invisible. In the absence of good light it is also difficult to observe all the particles. With this method deductions are made at the rate of one-tenth of a point for every two perceptible sediment particles.

On the other hand, scoring sediment from the bottom of the bottle offers the advantage of speed as no preparation of sediment discs are necessary. Furthermore, such sediment as may be noted by this method is comparable to that which may be noted by the consumer. In the examination of sediment in homogenized milk, observation of the bottom of the bottle is the only way to get a reliable indication of the amount of sediment present, for the nature of the sediment is such that it cannot be retained and examined by the sediment disc method. (Figures 17, 18 and 19.)

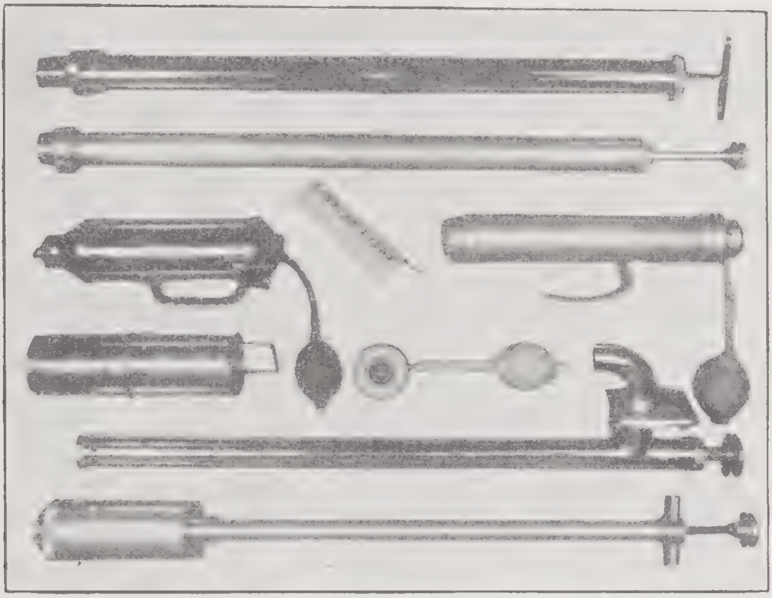

Figure 20 — Many Kinds of Sediment Testers Available for Making Sediment Tests on Milk.

In routine examination of non-homogenized bottled milk where emphasis is placed chiefly on the flavor quality of the milk, the observation of the sediment in the bottom of the bottle is desirable, but it must be remembered that the method furnishes an indication only of the presence or absence of particles too large to be "rafted" upward into the cream layer.

The sediment disc method of scoring sediment offers possibilities of detecting sediment not possible by the bottle method. By this method the sediment is concentrated and firmly fixed on a white cotton or lintine disc, where it may be studied carefully. The sediment discs are made by filtering one pint of milk through a round white, cotton pad 1¼ inches in diameter. Some sediment testers are shown in Figure 20. The sediment pads are protected by placing them on a cardboard receptacle and covering with cellophane or placing them in a clean, covered, shallow, glass petri dish.

Each disc may then be compared to a standard chart showing the rating merited. To score perfect on sediment there should not be any trace whatsoever of foreign particles on the disc, or any discoloring of the disc, except possibly that due to the natural pigments of the milk. Deductions are made in accordance with the amount, kind, and size of foreign particles present, as

well as for any smudgy appearance. If the milk were not strained or filtered on the farm the amount of sediment on the disc would indicate the general cleanliness in production. If the milk were strained or filtered the amount of sediment indicates the efficiency of the process or the amount of sediment subsequently accumulated.

If the nature of the sediment can be determined, it will aid much in determining the general care exercised in the production and handling of the milk. Sediment can be divided into two general classes, inorganic material and organic material, including metallic particles. It is reasonable to suspect that fewer undesirable micro-organisms would be carried into the milk by inorganic material than by organic material, especially if the organic material were from intestinal sources. Metallic particles would not be very detrimental from a bacteriological standpoint but may have an influence on flavor deterioration of the milk upon storage. Strange as it may seem, a high positive correlation between the amount of sediment in milk and the bacteria count, or the flavor score, cannot be established. It is, therefore, reasonable to conclude that the removal of sediment from milk is justified mainly from the esthetic standpoint as the process results in the milk having a more appetizing appearance.

When examining the sediment of bottled milk by the disc method, an evaluation is made by actually comparing the cotton disc with a chart or by comparing the disc with a mental image of the chart. For this purpose the chart prepared by the United States Department of Agriculture, shown in Figure 21, is being used. In using this chart it is well to remember that deductions of one-tenth point (0.1) may be made between 9.5 and 10.0 and twenty-five hundredths (0.25) between 8.0 and 9.5. The normal range of score on sediment in bottled milk is from 8 to 10. Practice in scoring sediment discs, such as shown in Figure 22, gives the beginner confidence in scoring.

Bacteria — 35 points

The bacteria count of milk reveals the general condition under which the milk was produced, handled and held. High quality milk is low in bacteria, but low bacteria milk may not always have the highest quality flavor. If off-flavors in milk are the result of bacterial growth, the bacteria count is usually in the

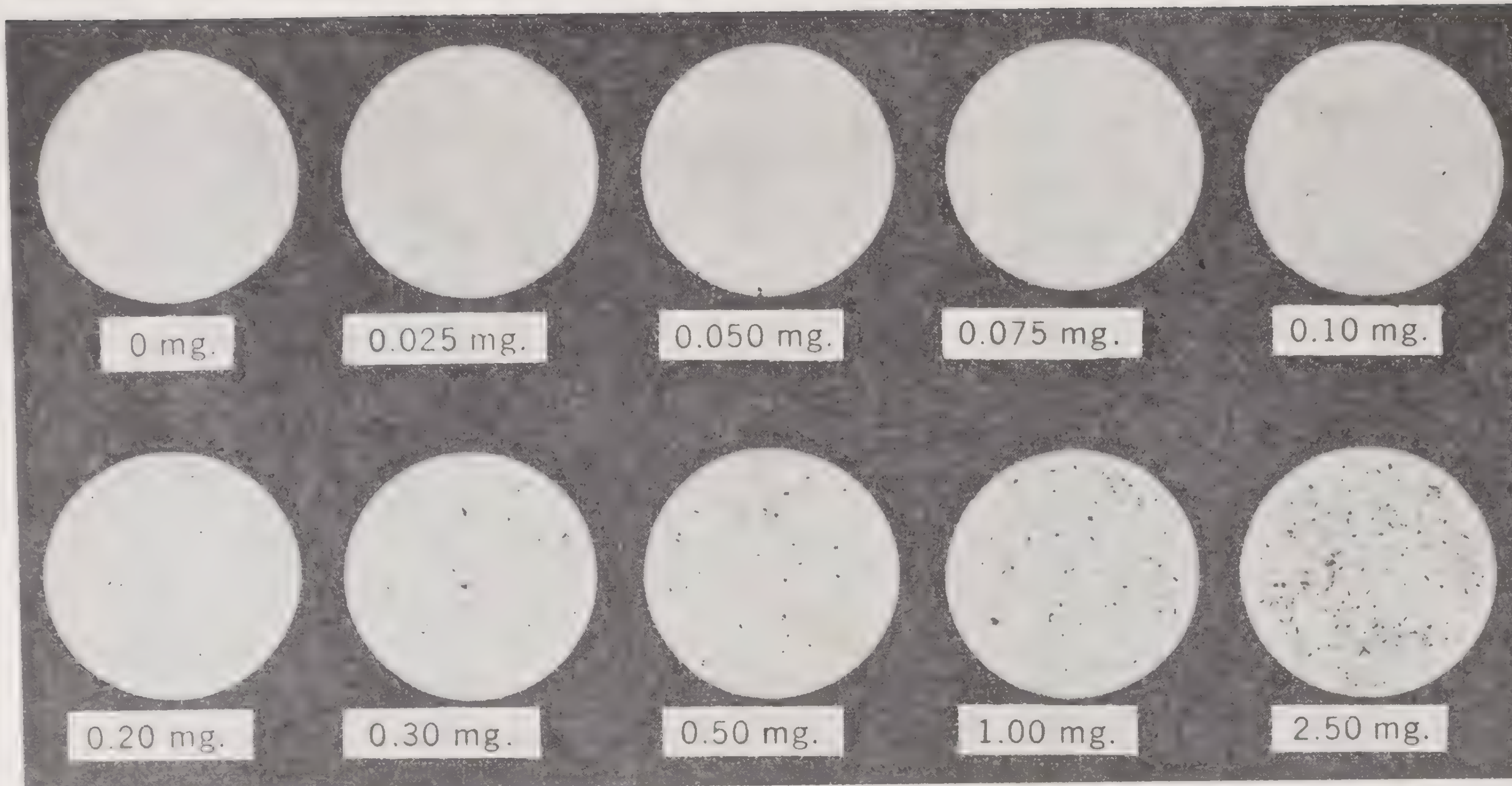

Figure 21—The numbers indicate the milligrams of sediment per pint of milk. In bottled milk, the disc representing 0.0 mg. of sediment scores 10; the disc representing 0.025 mg. of sediment scores 9; and the disc representing 0.050 mg. of sediment scores 8.

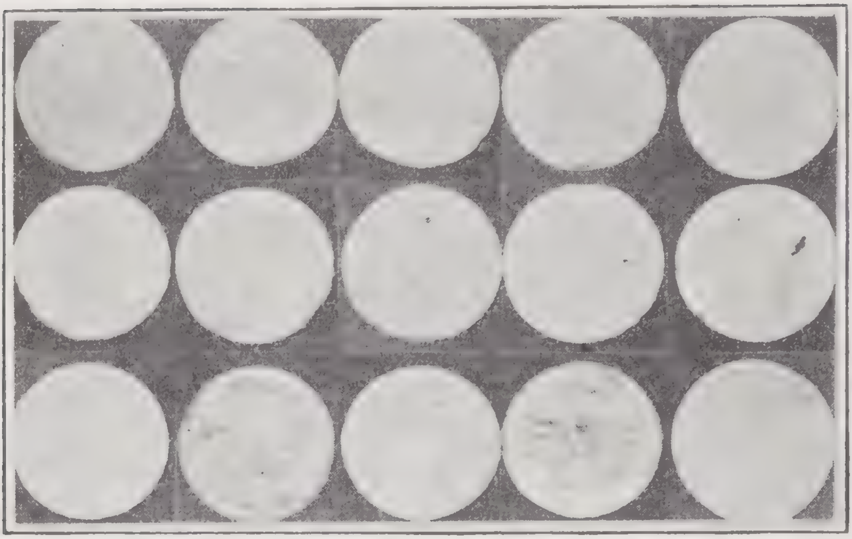

Figure 22 — Sediment Discs From Various Milk Supplies. By Evaluating Such Discs With and Without the Use of the Official Guide One Gains Proficiency in the Scoring of Sediment Discs.

millions per ml. Off-flavors in low bacteria milk always result from causes other than bacteria. Thus, little or no correlation exists between the bacteria count and the flavor quality unless there is sufficient growth and development of micro-organisms to form by-products in it, and in such case the physical appearance of the milk may be changed.

The scoring of milk for bacteria is a laboratory routine which can be done by a laboratory technician regardless of his knowledge or experience in milk judging. The scale of deductions is given on the score card in Figure 8a. Milk is allowed a perfect score for bacteria in student milk judging contests.

The specific rating of bacteria is considered especially in "pick up" or "surprise" contests. One of the functions of such a contest is to determine the sanitary quality of the milk supply delivered to the consumer.

Flavor — 45 points

The flavor of normal whole milk is pleasantly sweet, possessing neither a foretaste nor an aftertaste other than that imparted by the natural richness. Many beginners make a mistake of expecting a sample of good flavored milk to have a "taste." The beginner should remember that when milk does possess a so-called taste there is usually something wrong with the flavor. He should bear in mind especially that *excellent milk is pleasant-*

ly sweet and leaves only a clean, pleasing sensation after the sample has been expectorated. The mixed sample must also be homogeneous showing no buttery particles. When the closure of the unshaken bottle is removed there should be no adhering cream, foam or butter and the milk should not have a cream plug.

The beginner will soon develop confidence in his ability to judge milk if he will first learn to place the samples of milk into the general flavor groups, namely: excellent, good, fair, poor or bad. After placing the samples into these general flavor groups, the next step is to rate the sample within the group; that is whether the flavor quality is such as to place it as average, high, or low in that group. Since each group has a numerical score range it thus becomes relatively easy to place a numerical flavor score on the sample of milk.

Flavor is never given a perfect flavor score of 45 points. The normal range of flavor scores is from 25 to 42 points with perhaps the majority of samples scoring between 30 and 40. In order to classify as market milk the flavor should be such that it is marketable. Some samples of poor quality may deteriorate from the time they were prepared for sale and the time they are scored. In such case the off-flavor may develop to the extent that it is unfit for use as market milk. Milk that is unfit for use as market milk is given a 0 score on flavor.

1. Distribution of milk flavors. Trout and associates (1940) made a study of the occurrence of off-flavors in the milk samples used in the Collegiate Students' International Contest in the Judging of Dairy Products (Figure 23) from 1927 to 1938, inclu-

Figure 23 — A Group of College Students Judging Milk in the Collegiate Students' International Contest in the Judging of Dairy Products. (Courtesy Dairy Industries Supply Association.)

sive. It was recognized that inasmuch as specific flavor samples may have been selected, the percentage distribution of the criticisms might not apply to commercial bottled milk as a whole. However, the data give a fair indication of the relative occurrence of off-flavors in milk.

They found that during the twelve-year period from 1927 to 1938, inclusive, 88.1 percent of milk samples used in the national contests were criticized on flavor by the official judges. For each sample criticized on flavor an average of 1.27 criticisms was given. The percentage distribution of the off-flavors noted in the samples is shown in Figure 24. "Feed" and "cooked"

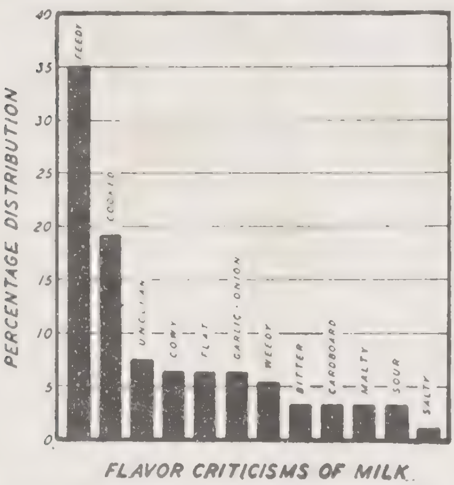

Figure 24 — Distribution of Official Flavor Criticisms of Samples of Milk Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1927 to 1938, Inclusive.

flavors dominated the criticisms with 35.11 and 19.14 percent respectively, a total of 54.25 percent. Following this group came the "unclean," "flat," "cowy," "onion" or "garlic" and "weedy" flavors, with 7.44, 6.38, 6.38, 6.38 and 5.32 percent, respectively, a total of 31.90 percent. The remaining 13.85 percent was divided among "malty," "cardboard," "bitter," "sour" and "salty" flavors.

Combinations of flavors were not so readily noted in milk as in butter and cheese. When used, however, "feed" was usually one of the flavors given, the combinations being "feed, salty"; "feed, unclean"; "feed, cowy"; and other similar combinations.

2. Evaluation of off-flavors. Trout and associates (1942) asked a panel of five selected milk judges to place an evaluation on a number of milk flavors having specific intensities. The data secured were tabulated and are presented in Table 4. These data

Table 4 — Classification of Flavors of Milk According to the Class of Milk

Class of milk* with approximate score	Flavor criticism	Intensity of flavor	Average score given by selected judges	Class of milk* with approximate score	Flavor criticism	Intensity of flavor	Average score given by selected judges
Excellent (40–45)	....	....	40 and above				
Good (37–40)	Flat	Slight	39.5	Poor Cont'd. (25–34)	Bitter	Distinct	30.7
	Cooked	"	39.1		Metallic	"	30.3
	Feed	"	38.8		Salty	Strong	30.1
	Flat	Distinct	38.4		Weedy	Distinct	29.9
	Salty	Slight	37.4		Malty	"	29.7
	Cooked	Distinct	37.1		Musty	"	29.5
					Unclean	"	29.1
Fair (34–37)	Flat	Strong	36.6		Oxidized	"	28.9
	Metallic	Slight	36.4		Disinfectant	"	28.1
	Malty	"	36.2		Rancid	"	27.1
	Cowy	"	36.1		High acid	"	26.9
	Feed	Distinct	35.7		Garlic; onion	"	25.7
	Bitter	Slight	35.6		Cowy	Strong	25.4
	Oxidized	"	35.5		Bitter	"	25.2
	Weedy	"	35.5				
	Musty	"	35.1				
	Unclean	"	35.1	Bad (25 or below)	Malty	Strong	24.0
	Cooked	Strong	34.4		Metallic	"	24.0
	Salty	Distinct	34.3		Weedy	"	24.0
					Unclean	"	22.6
Poor (25–34)	Disinfectant	Slight	34.0		High acid	"	21.6
	High acid	Slight	33.3		Oxidized	"	21.6
	Rancid	"	33.1		Musty	"	20.2
	Garlic; onion	"	32.5		Disinfectant	"	19.2
	Cowy	Distinct	31.1		Garlic; onion	"	19.2
	Feed	Strong	31.0		Rancid	"	19.2

*Suggested by committee on score cards, A. D. S. A., C. J. Babcock, Ch.

should furnish a good guide for the beginner in classifying the milk into groups and in giving the off-flavor a specific evaluation.

3. Undesirable flavors in milk. Milk has a flavor defect if it has an odor, a foretaste or an aftertaste, or does not leave the mouth in a clean, sweet, pleasant condition after tasting. Some samples may have more than one flavor defect. In this case the flavor score is reduced to correspond to the most outstanding one. Described herein are those flavors of milk which may be encountered most frequently in the judging of market milk. The list includes:

a. Barny, "smothered" (cowy), unclean.
b. Bitter, rancid.
c. Cooked, heated.
d. Feed.
e. Flat.
f. Foreign, disinfectant.
g. High acid.
h. Malty.
i. Metallic, oily, oxidized, stale, tallowy, (cardboard).
j. Musty.
k. Salty.
l. Weedy.

For convenience to the beginner these flavors are classified and evaluated in the accompanying guide, Table 5, which is based on the evaluations given the various milk flavors by the selected milk judges as previously reported.

The description and taste and smell sensations of the different off-flavors frequently encountered in milk are as follows:

a. Barny, "smothered" (cowy), unclean. These flavors are grouped together inasmuch as the sensations of smell and taste are so similar that it is difficult to distinguish with certainty one from another. Milk with these flavors has a rather unpleasant distinct odor. The difference between the flavors seems to be a matter of intensity rather than a difference in characteristics. Apparently they are all associated with poor ventilation of the cow stable, with improper feeding routine, with physical contamination or with a combination of these causes. If cows are stabled and milked in a poorly ventilated, foul smelling

Table 5 — General Guide for Scoring Flavor of Milk

Class of milk as to flavor	Range in score	Specific flavor description
Excellent	40–45	No criticism.
Good	37–40	Slightly to distinctly cooked; slightly feed; slightly to distinctly flat; slightly salty.
Fair	34–37	Pronouncedly cooked or flat; distinctly feed or salty; slightly bitter, cowy, malty, metallic, musty, oxidized, unclean, weedy.
Poor	25–34	Pronouncedly feed, salty. Distinctly to pronouncedly bitter, cowy. Distinctly malty, metallic, musty, oxidized, unclean, weedy. Slightly to distinctly disinfectant, high acid, rancid, garlic, onion.
Bad	0–25	Pronouncedly disinfectant, high acid, garlic, onion, malty, metallic, musty, oxidized, rancid, unclean, weedy.

atmosphere a pronounced barny, cowy or unclean odor is very likely to be present in the milk. If the odor is slight, often it is termed "smothered" or "feverish"; if more intense, "cowy"; if pronounced, it may be called "barny" because the odor does resemble that of a poorly kept, inadequately ventilated barn. When the flavor is very pronounced it is sometimes called "unclean" because it does have an odor suggesting uncleanliness even though the milk has been produced under very satisfactory sanitary conditions, as indicated by a low bacterial count. These flavors are easily detected by the sense of smell, but are noticed by taste also. They are most noticeable immediately after the sample has been expectorated. The taste sensation is persistent. The palate fails to clean up.

b. Bitter, rancid. These flavors are grouped together because in the majority of cases they will be associated. The specific, distinct, bitter taste may occur in milk as a result of cows having had access to some kind of weeds or it may be due possibly to some physiological disturbance. Generally, the bitter flavor in milk results from the activity of the enzyme lipase and thus will be encountered with rancidity so frequently that the presence of a bitter, soapy taste in the milk might well be regarded as an

indication of rancidity. A pure, unassociated bitter flavor can be detected by taste only. There is no odor. The taste reaction time of *bitter* is slow to the extent that the first sensation conveys the suggestion that the milk is of good flavor. The bitter taste persists long after the sample has been expectorated.

Bitterness associated with rancidity is accompanied by a strong, disagreeable odor, which if pronounced, is somewhat pungent. The rancid flavor can be detected both by the sense of smell and by the sense of taste. The flavor is disagreeable and often exhibits a soapy characteristic. The flavor somewhat resembles that of a spoiled nut meat which has turned dark in color. Beginners sometimes confuse the rancid odor with that of the odor of a high acid sample. At certain stages of development these two odors may have some characteristics in common, but they can be easily differentiated by taste. Rancidity is associated with a persistent, repulsive bitterness, whereas the high acid flavor has a short adaptation time, thus soon creating the sensation of cleanliness. Homogenized raw milk or mixtures of pasteurized, homogenized milk and raw nonhomogenized milk yield good examples of rancidity.

c. Cooked, heated. The terms "cooked" and "heated" used to describe certain flavors in milk are used too frequently interchangeably and incorrectly. The terms "cooked" and "boiled" might well be used interchangeably for the flavors are one and the same. However, cooked and heated flavors differ markedly from each other, both in intensity and in quality. This can be demonstrated by sampling and tasting milk which has been heated momentarily to various temperatures up to the boiling point of milk. Gould and Sommer (1939) showed that the cooked flavor of milk appeared abruptly within a very narrow limit at a temperature of 76° to 78° C. (168.8° to 172.4° F.). Below this temperature the heated milk did not have the cooked flavor. Later, Gould (1944), indicated that possibly the heated flavor of pasteurized milk was a result of the blending or dilution of the cooked flavor with that of normal milk. Thus the heated flavor might result from heating a film of milk to the cooked flavor producing tem-

perature and then remixing it with the remainder of the milk. Such is possible, when, in pasteurizing, a high-temperature heating medium is used, unequal distribution of heat occurs, or there is a slow movement of the milk over the heating surface.

Both the heated and the cooked flavors are easily identified. The taste reaction time is quick and the taste sensation remaining after expectorating the sample is pleasant. The cooked flavor especially may be noted by the sense of smell. Its volatility gives the judge a hint as to the flavor of the milk as the sampling cup is brought to the lips. The presence of heated flavors in milk is not particularly objectionable, but the truly "cooked" flavor is frowned upon. The beginner will soon recognize that if and when the heated flavor is present it will not be associated with the oxidized flavor. Thus, as in ice cream, this flavor is recognized as "the flavor of assurance" of the keeping quality of milk insofar as oxidization is concerned.

d. Feed. Some feeds taint the milk if fed to cows shortly before milking. This is especially true of succulent feeds and some of the hays. The feed flavor is characteristic in that it is aromatic, somewhat pleasant and can be readily detected by the sense of smell. The characteristic cleanliness of feed flavors when the sample of milk is rejected from the mouth, distinguishes them from the cowy or barny flavors. The feed flavors disappear rather quickly leaving the mouth clean, while cowy or barny flavors persist with an unclean aftertaste. The beginner will likely experience considerable difficulty in distinguishing between barny and feed flavor. However, he may be encouraged by the fact that even experienced milk judges are not always in perfect agreement on these two flavors.

e. Flat. This is one of the easiest flavor defects to detect. Since it is not associated with an odor, the sense of smell furnishes no indication of its presence. However, when the milk is tasted the flatness is apparent soon after the sample reaches the tongue. The flavor defect can be simulated by adding water to a sample of milk and noting the flavor of the mixture. A flat flavor should not be confused with one lacking richness. The latter usually exhibits a sweetness whereas the former does not.

f. Foreign, disinfectant. As the name implies, a foreign flavor is one not commonly developed in or associated with milk. The foreign flavor in milk may be detected by the sense of smell or may not be noted readily except when the sample is tasted. The characteristics of the flavor differ according to the cause. Foreign flavors in milk may be caused by improper use of coal tar disinfectants or chemical sterilizers, exposure to fumes from the combustion or burning of gasoline or kerosene, contamination from fly repellants, drenching the cow for bloat with certain chemicals or treatment of the udder with ointments. If any of these flavors are pronounced the milk is unfit for use, and therefore, merits a 0 score on flavor.

g. High-acid. The high-acid flavor is easily detected, both by the sense of smell and by the sense of taste. When S. lactis and other acid producing organisms grow in milk, changing the milk sugar into lactic acid and other by-products, an unpleasant, somewhat disagreeable odor is produced by the by-products formed. The sense of smell detects this odor easily. Up to this point, usually sufficient acid is not yet produced to be detected by the sense of taste alone. As the fermentation progresses, the odor becomes less offensive and the acid taste more pronounced. High-acid milk conveys to the tongue a peeling effect, leaving both the tongue and the mouth with a feeling of cleanliness. Milk with a detectable acid flavor is scored 0 on this item as the product is not saleable as market milk.

h. Malty. Malty flavor in milk is usually pronounced and is very suggestive of malt. Variations of the flavor may be encountered. One variation may suggest a walnut or a maple flavor, while another may suggest a grape-nut flavor. The malty flavor is generally caused by the growth of *S. lactis var. maltigenes* or by associative action of certain bacteria in the milk. The flavor can be readily detected by either the sense of smell or by the sense of taste.

i. Metallic, oily, oxidized, stale, tallowy (cardboard). These terms describe the various intensities of the flavors resulting from the oxidation of some of the fatty constituents of the milk. As the flavor develops it passes through

various stages from a flat, slightly metallic sensation, through that of paper to a definitely oily, old meat, tallowy taste. The flavor defect is encountered infrequently in raw milk, but may be noted very frequently in the pasteurized product, particularly during the late winter months if the milk is exposed to copper contamination *after* pasteurization. The flavor will not be observed in homogenized milk so should not be confused, therefore, with the activated flavor sometimes observed in that product. The oxidized flavor is characterized by a ''quick'' taste reaction when the sample is taken into the mouth and by its resemblance to some of the flavors mentioned above and by its relatively short adaptation time. The defect can be detected also by the odor but it is especially perceptive to the sense of taste. The flavor is not persistent after the sample is expectorated.

j. Musty. Musty flavor in milk is somewhat similar to that of musty hay, and is suggested by the faint odor usually present. The odor often conveys also the suggestion of a damp, musty, poorly ventilated vegetable cellar. The flavor is persistent after the sample has been rejected from the mouth.

k. Salty. The salty flavor of milk is one of the easiest to detect. It may be perceived quickly upon placing the sample into the mouth. The sense of smell is valueless in detecting this flavor, as there is no odor from salty milk unless the flavor is in association with another defect. Salty milk gives a cleansing feeling to the mouth. This flavor is commonly associated with milk from cows far advanced in lactation and sometimes with milk from cows having mastitis.

l. Weedy. There are many weeds that will taint the milk when fed to the cows. This is especially true if they are fed a short time before milking. The character and the intensity of the weed flavor will depend on the kind of weed and the elapse of time between feeding and milking. Frequently, the weed flavor is associated with a bitter flavor. The different weeds that will taint milk differ with the localities and are generally seasonal. Milk judges should familiarize themselves with such weeds in each

locality as will taint milk. They should also know the characteristics of each flavor when found in milk and be able to suggest a feeding routine that will very largely eliminate these flavor defects. The flavor score of milk with a weedy flavor will depend upon the intensity, and whether or not it is caused by a common or by an obnoxious weed.

GRADING BOTTLED MILK ACCORDING TO A METHOD BASED UPON THE FEDERAL SYSTEM OF GRADING BUTTER

A method of scoring bottled market milk comparable to that now in use by the Federal graders in grading butter has been proposed by Downs (1942). The system has considerable merit in that it places emphasis upon the wholesomeness and palatability of milk, i.e., the flavor, and makes certain deductions from the flavor grade for defects in bottle and closure and in sediment. In actual practice, the judge would place a score grade on the milk according to the flavor. Then, after checking items of bottle and closure and sediment, he would make deductions according to the value of the defects noted in these items and according to the tolerances permitted in milk having the specific flavor. The defect ratings for bottle and closure and for sediment, and the tolerances for each flavor grade, are tabulated so the scoring of these items becomes merely mechanical. However, nothing is detracted from the flavor scoring. There are no short cuts to ascertaining the flavor quality. Sampling and tasting techniques and knowledge of milk flavor characteristics as previously described, as well as experience, are as essential in this system of grading milk as in the score card method.

TRACING THE CAUSES OF OFF-FLAVORS IN MILK: A GUIDE

The examination of innumerable samples of milk for flavor has shown that certain understandings and techniques are helpful in diagnosing the causes or the contributing causes of milk flavor defects (Trout, 1945). The causes of many milk flavor defects can be classified. The distinguishing characteristics of each defect may enable the field man, plant superintendent or milk inspector to trace the off-flavor to its source after which it may be eliminated.

Table 6 — General Distinguishing Characteristics of Off-Flavors in Milk

Cause of off-flavor	General distinguishing characteristics of the off-flavor in the milk
Bacteria growth	**Unusually high** bacteria count: From 1,300,000 to 305,000,000 per ml. as found by different investigators.
Feed	Bacteria count may be low; flavor present when milk is drawn; usually more intense in night's milk; usually present when cows have had access to roughage shortly before milking; odor pronounced.
Absorption Direct:	Encountered very infrequently; results only after **long** exposure to **very** odoriferous atmosphere; odor **not** present when milk is first drawn.
Indirect, through cow breathing foul air:	Bacteria count may be low; odor of milk suggests uncleanliness; odor present when milk is first drawn.
Chemical composition of milk	Flavor defect is noticeable when the milk is first drawn; milk usually distinctly salty; inherent to individual animal, rarely in mixed milk; defect more likely from animal advanced in lactation or one with infected udder.
Processing	Pasteurized, "heated" or modified "cooked" flavor. Detectable immediately after processing; usually not very intense; tends to disappear during storage.
Chemical	Not present when milk is first drawn or immediately after pasteurization; develops readily at low temperatures — below 40° F. (4.5° C.); bacteria count low. Three types: a. **Rancidity** — In raw milk only; bitter, soapy flavor; defect more intense in cream than in milk and more intense in butter than in cream. b. **Oxidized** — Chiefly in pasteurized milk; papery; tallowy; odor somewhat like wet cardboard. c. **Activated** — In pasteurized milk exposed to light; suggests burnt protein.
Foreign material	Defect present in freshly bottled milk; rarely increases in intensity during storage; taints varied; may resemble brine, medicine, paint, fly spray, or any other strong substance with which the milk may have been contaminated.

Distinguishing characteristics of the general causes of off-flavors in milk. Different groupings of the causes of off-flavors in milk have been suggested. The following classification modified after those given by Hammer (1938) and by Sharp (1941) appears to be the most complete.

1. Bacterial growth.
2. Feed.
3. Absorbed.
4. Chemical composition.
5. Processing and handling.
6. Chemical changes (enzymatic and catalytic).
7. Addition of foreign material.

Each group of causes of off-flavors has some distinguishing characteristics which aid in the identification and in the elimination of the source of the defect. The general distinguishing characteristics are given in Table 6.

Obtaining indications of the possible cause of off-flavors. To overcome a milk flavor defect its cause must first be sought. To find the possible cause the milk judge attempts to trace the trouble by seeking answers to a number of questions, generally in the following order.

1. What does the taste of the milk resemble?
2. Are customer complaints occasional or general?
3. Is the milk raw or pasteurized?
4. Does the defect occur sporadically or has it persisted over an extended period of time?
5. Is the defect present immediately after the milk is drawn?
6. If not present when the milk is drawn how long does it take to develop to a definite intensity?
7. What is the bacteria count of the milk?
8. Does the defect occur in mixed milk or only in the milk from individual cows?
9. What kind of roughage is fed to the cows?
10. How much time elapses between the time of feeding the roughage and milking time?
11. Has the milk come in contact with copper equipment?
12. How long has the milk been held in the refrigerator?
13. Does every-other-day delivery aggravate the problem?

In seeking the answer to these questions the milk judge realizes that (a) certain flavors are present only in raw milk, rancid-

ity for example; (b) bacteria counts must be in the millions per ml. in order to cause a flavor defect; (c) a sudden general outbreak of flavor complaints usually indicates foreign contamination, or a general radical change in feeding practices; (d) a general increasing number of complaints on pasteurized milk over an extended period usually indicates an oxidized flavor; and that (e) flavors resulting from direct absorption very seldom occur.

Seasonal occurrence of flavor defects: A knowledge of the general occurrence of milk flavor defects in the different months of the year is very helpful in seeking the cause. Certain defects are particularly seasonal in their occurrence and are noted rarely during other seasons of the year. The seasonal occurrence of some of the most troublesome off-flavors of milk are given in Table 7. It will be noted that the oxidized flavor is strictly a winter or dry-feeding-period flavor defect. As soon as the cows are fed on green, succulent pasture for a short time after being on dry roughage the defect does not occur. Likewise, rancid flavor is largely a late fall, winter or early spring defect largely because in this season many of the cows are in the late stage of lactation, as well as on dry feed. Salty milk will also most likely be noted during late fall, winter or early spring seasons.

Feed flavors are encountered chiefly during the early pasture season, when the cows are first fed on green pasture grass. Feed flavors rarely occur during the drying-pasture season, but may recur again in the early fall if the pastures again become green due to fall rains. Cows pastured on legumes up to the time of milking yield feed flavored milk. Silage flavors are usually more pronounced in late winter. This is apparently due to poor ventilation in the barn and to stronger odor in the silage at this season.

Tracing the flavor defect to individual cows: Occasionally it is desirable to taste the milk from individual cows in order to locate the contributing cause of an off-flavor. For this purpose, approximately one-half pint sample of the night's milk and the same amount of the morning's milk should be taken separately from each cow. The samples should be marked so the person judging them will have no knowledge of their identity. After the findings have been recorded, the samples are identified as to the individual cow and the time of the milking. Very often the

Table 7 — The Period of the Year When Certain Off-Flavors of Milk Are More Likely To Be Encountered

Flavor defect	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Alfalfa pasture							xxxx	XXXXXXXX	xxx...			
Barny	xxxxxx	xxxxxxx	.....							......	...xxxx	xxxxxxxxx
Foreign	. . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
Grassy					xxXXXX	xxx...			...xxxx	xx....		
High-acid, sour					......	xxxXXXX	XXXXXXXX	XXXXXXXX	XXXxxxx	......		
Malty					...	xxxx	XXXXXXXX	XXXXXXX	xxxxxx.	....		
Oxidized	xxxxx	XXXXXXXX	XXXXXXXX	XXXXXXXX	XX						......	..xxxxxx
Rancid	xxxxx	xxxxXXX	XXXxx..							......	...xxxx	xxxxxxxx
Rye				XXXXXXX	XX							
Salty	xxxxxx	xxxxxxx	xx.....	.....				...	....	......	xxxxxxxx	xxxxxxxx
Silage	xxxxxx	xxXXXXX	XXXXxxx	x....								

Key: .... flavor occurring occasionally or spotty.
xxxxxxx flavor occurring frequently.
XXXXXXX flavor most troublesome.

flavor trouble can be traced to the night or to the morning milking of an individual cow.

If the mixed raw milk becomes rancid upon standing it is desirable to ascertain which cows are producing milk contributing particularly to this flavor defect. This may be done by holding samples from individual cows at 40° F. (4.5° C.) or lower for 24 to 48 hours and scoring them for flavor. By segregating milk known to be susceptible to the development of rancidity the remainder of the milk likely will be satisfactory so far as rancid flavor is concerned. Usually, it is the milk from cows in the advanced stage of lactation and producing only a small amount of milk that is responsible for the flavor defect. This is also true of a salty taste. However, a salty taste may be noted in milk from a mastitis infected udder regardless of the stage of lactation or the number of pounds of milk yield.

Tracing the focal point of copper contamination in a plant: When an oxidized flavor occurs in pasteurized milk it is generally advisable to locate the focal point of metal contamination. It is also advisable to ascertain if the milk of one or more cows or herds is particularly susceptible to oxidation. Metal contamination can be traced by taking samples all along the line of processing, using an *aluminum* dipper or *pyrex* beaker and collecting the samples in one-half pint milk bottles. Samples should be taken at different stages of the pasteurization process and numbered as follows:

Key*	No.	Source of sample		Flavor after 48 hours at 40°F. (4.5°C.)
G	1	Raw:	taken from the pasteurizing vat before heating.	
C	2	Pasteurized:	taken directly from the vat after heating.	
F	3	Pasteurized:	taken at the inlet to the cooler.	
B	4	Pasteurized:	taken at the outlet of the cooler.	
E	5	Pasteurized:	taken at the inlet to bottler supply tank.	
A	6	Pasteurized:	taken from the bottler supply tank.	
D	7	Pasteurized:	the final bottled product.	

* Suggested identification letters which may be put on the samples when they are given to the milk judge to be examined for flavor so that he does not know the source of each sample.

After being held for 48 hours at 40° F. (4.5° C.) or lower the samples should be examined by an experienced milk judge who does not know the identity of the samples. The flavors found should be recorded on a separate record sheet according to the key letter on each sample. It is desirable to record the intensity as well as the presence or absence of oxidized flavor. For this purpose the following guide has been found satisfactory:

—, no oxidized flavor
?, questionable
+, slightly oxidized
++, distinctly oxidized
+++, very pronouncedly oxidized

The results of the presence or absence of oxidized flavor and the intensity found by the judge in each sample can be transposed to the respective space on the record sheet for study.

Sometimes it is desired to ascertain the susceptibility of mixed milk or of milk from individual animals to the development of the oxidized flavor. This may be done by dividing the samples into two or three lots keeping one lot as a raw control, holder pasteurizing a second lot, and holder pasteurizing a third lot after which 0.25 parts per million of copper is added. If doubt exists as to the nature of oxidized flavor a sample representing this flavor may be prepared by adding 0.50 milligrams of copper sulphate ($CuSO_4.5H_2O$) per liter of winter milk and storing the sample at 40° F. (4.5° C.) or below for 48 hours (Trout and Sharp, 1937). The addition of 0.25 parts per million of copper to a liter of milk may be accomplished by adding one ml. of a prepared copper sulphate solution to 100 ml. of milk. The copper sulphate solution may be prepared by adding 0.098 or approximately 0.1 gram of copper sulphate ($CuSO_4.5H_2O$) to one liter of distilled water. Fifty-one hundredths ppm. of copper may be added to a liter of milk by doubling the volume of solution used. In every case the copper should be added *after* pasteurization.

CHOCOLATE MILK

Every milk judge is called upon from time to time to judge chocolate milk. In judging the product he should keep in mind that chocolate milk is milk to which a clean, sound chocolate syrup has been added in a sanitary manner. Chocolate milk may or may not show a cream line and may vary markedly in other respects.

The examination of the bottle and closure of chocolate milk is made similarly to that in judging other bottled milk. These items are subject to the same defects and are given a corresponding evaluation. In judging other qualities of chocolate milk, however, an entirely different set of standards is employed. Emphasis is placed on the appearance, color, viscosity, flavor, and freedom from sedimentation.

1. *Appearance.* Except when a creaming chocolate milk is desired, chocolate milk should show uniformity of appearance throughout. When creaming is permitted both the underlayer and the cream layer must show uniformity within themselves, but may vary in the intensity and hue of color. The defects in the appearance of chocolate milk with which the judge should be familiar are (a) stratification, (b) mottled, or curdy, and (c) presence of air bubbles. These defects may be recognized easily, but when present to a slight degree are often overlooked in casual examination of the product. The possibility of their occurrence should be kept in mind.

2. *Color.* Chocolate milks may vary widely in color, but the product may not be criticized in this respect if the color ranges from a light to a reddish-brown color such as may be associated with cocoas or chocolate. The intensity of color should be neither so light nor so deep as to lack appeal to the eye. Possible defects in the color of chocolate milk are (a) unnatural, (b) too light, (c) too dark and (d) lack of uniformity.

3. *Viscosity.* Wide differences in opinion exist as to the desired viscosity in chocolate milk. Some believe that chocolate milk should have the same viscosity as normal milk. Others prefer a thick, viscous product. If creaming is permitted, a thin body or light viscosity comparable to normal milk may be expected. If, however, the creaming is inhibited as the result of the addition of a small percentage of stabilizer, then the chocolate milk will be more viscous than normal milk. It is not desirable to have a viscosity so thick that it pours like syrup nor one which creates a slimy sensation when taken into the mouth. Leniency should be shown toward a slightly increased viscosity to inhibit creaming but the highly viscous product should be criticized.

4. *Flavor.* Chocolate milk should have a *chocolate* flavor somewhat like that of fresh, high-quality chocolate candy. The

sweetness should be of medium intensity so the appetite will not be satiated quickly. Inasmuch as different varieties and processes of cocoas and chocolates may be used in preparation of the syrup intended for chocolate milk, and that attempts may be made to enhance or fortify the chocolate flavor by the addition of one or more of such products as vanilla, cinnamon, nutmeg, or other spices, malt, or salt, a variety of flavors may be noted. Also the type of sweetener used may impart a non-chocolate flavor. Molasses is an example. The chief flavor defects of chocolate milk which may be encountered are (a) unnatural and (b) too sweet.

5. *Sedimentation.* The settling of chocolate and cocoa in chocolate milk is very common. While it is not particularly objectionable it does have the disadvantage of contributing toward an unfavorable appearance in the bottled product. In aggrevated cases the dark chocolate forms a distinct layer under a very light "white-livered" upper layer. Furthermore, the consumer is obliged to agitate the milk vigorously to make the product homogeneous.

In judging chocolate milk for sedimentation raise the bottle slightly above the level of the eyes. Note the amount of sedimentation, the quality or fineness of sediment and the readiness with which it remixes with the milk. Homogenized chocolate milk shows more sediment than the same product non-homogenized.

SKIMMILK

A milk judge may be requested occasionally to judge bottled skimmilk. This product is free from many possible defects of bottled whole milk. Since skimmilk obtained in the milk plant results from the centrifugal separation of whole milk, the product is essentially clarified and should be remarkably free from sediment. Thus, the presence of sediment in bottled skimmilk is particularly objectionable as it indicates carelessness in subsequent processing and handling, or in the use of poorly washed or non-protected containers. The product should show no cream film or layer. Since skimmilk tends to foam badly, particularly at low temperatures, difficulty may be encountered in securing a proper fill. The judge, therefore, should be on the lookout for slack-filled bottles. While the flavor of skimmilk is pleasantly sweet, it definitely lacks the richness and palatability of whole

milk. The flavor is not flat in the same sense as the flavor of watered milk, but skimmilk definitely lacks rich flavor. Different samples of skimmilk seem to have a sameness of flavor, whereas a number of samples of whole milk may exhibit a variety of different flavors. Frequently, skimmilk may have an off-flavor which suggests that of paper. This flavor must not be confused, however, with the true oxidized flavor as noticed frequently in pasteurized whole milk.

Mojonnier and Troy (1925) discuss the scoring of skimmilk in part as follows:

> "The scoring of skimmilk has heretofore received very little consideration. The greater value now placed upon skimmilk as a food and the larger application of skimmilk products as a food and in the arts, makes it very desirable to have a score card that gives in a systematic way the respective points that good skimmilk should possess and provide space for recording the necessary data relating to samples scored.
>
> "The score card need not differ in principle from that used for whole milk but the credits allowed for the different points may vary somewhat in proportion to their influence upon the value of the skimmilk in the use that is to be made of it. The explanation of scores given for whole milk may be applied also for skimmilk."

The score card for skimmilk proposed by them is as follows:

Score Card for Skimmilk

Item	Perfect Score
Bacteria	35
Flavor and odor	20
Sediment	10
Solids not fat	15
Temperature (street sample)	5
Acidity	5
Fat	5
Container	5
Total	100

HOMOGENIZED MILK

Inasmuch as homogenized milk has certain specific characteristics and may have certain specific defects, the dairy products judge should examine homogenized milk somewhat differently than regular market milk. Tracy (1939) has proposed a score card for judging homogenized milk with the following comments:

> "As a means for encouraging the production of high-quality homogenized milk, the following score card is proposed. By the use of such a 'yardstick,' dealers will be able to determine to what extent the homogenized milk they are marketing measures up with the ideal."

Score Card for Homogenized Milk Proposed by Tracy

	Perfect Score	Score Allowed	Comments
Flavor	25	......	....
Visible sediment in quart bottle undisturbed for 24 hours	10	......	....
Bottle and Cap	5	......	....
Richness	15	......	....
Bacterial Count	25	......	....
Curd Tension	10	......	....
Fat Globule Rise	10	......	....
	100		

Explanation of the Score Card

Flavor — perfect score 25*

Common flavor defects — cardboard (tallowy), cooked, rancid, feed, disinfectant, weed, salty, sour, unclean, sunshine.

Excellent flavor	—	24-25*
Very good	—	23-23.5
Good	—	22-23
Fair	—	20-21.5
Poor	—	16-19.5
Very poor	—	12-15.5
Unsalable	—	under 12

Sediment — perfect score 10 — Send the bottle out on milk wagon and then permit it to stand undisturbed at 40° F. for 24 hours before examining the bottom for sediment.

*Flavor score given was based on the score card previously used.

Very clean	—	9.5-10
Clean	—	9.0-9.4
Fairly clean	—	8.5-8.9
Rather dirty	—	7.5-8.4
Dirty	—	6.0-7.4
Very dirty	—	under 6

Bottle and Cap — perfect score 5

Perfect score only when the bottle is full, clean, mouth is not chipped, and lip is protected with non-absorbent, machine-placed cover that is tamper proof and completely covers the pouring lip of the bottle.

Richness — perfect score 15

Perfect score — Four percent fat. For each 0.1 percent fat below 4, subtract 1 point from the score. Score zero, if less than the state legal standard.

Bacterial Count — perfect score 25

Perfect score — 10,000 bacteria per ml. or less

Over 10,000 —	under 50,000 —	score	23
Over 50,000 —	under 100,000 —	score	20
Over 100,000 —	under 250,000 —	score	15
Over 250,000 —	under 500,000 —	score	10
Over 500,000 —	—	score	0

Curd Tension — perfect score 10

Under 12	grams curd tension —	10
12-15	grams curd tension —	9
16-18	grams curd tension —	7
19-24	grams curd tension —	3
25-30	grams curd tension —	1
Over 30	grams curd tension —	0

Fat Globule Rise — perfect score 10

Any increase in fat content in the upper 70 ml. of a quart bottle undisturbed for 48 hours over the original test of the milk to be scored as follows:

Percent Increase	Score
0	10
1 - 5	9
6 -10	8
11-15	7
16-20	5
21-30	2
Over 30	0

Deduct 2 points for any visible cream plug.

GOATS' MILK

Occasionally the milk judge will have the opportunity to judge goats' milk. The American Goat Society, Inc., Lincoln, Nebraska, holds a National Goat Milk Scoring Contest annually in which goat breeders of many states are invited to participate.

Regularly produced samples are furnished a designated judge on a specified date. When these samples are assembled they are judged according to the following score card:

Score Card for Goats' Milk
(American Goat Society, Inc., Lincoln, Nebraska)

Item	Perfect score	Score allowed	Remarks
Bacteria	35	......	Plate count
Flavor and odor	25	......	....
Visible dirt	10	......	....
Butterfat	10	......	Percent found
Temperature at delivery	15	......	Degrees F.
Bottle and cap	5	......	Bottle
		......	Cap: Hand or machine set
		......	Lip protection: Complete
	——	......	Partial or none
Total	100		

The procedure in scoring goats' milk is similar to that previously described in scoring cows' milk. In scoring the milk for flavor the judge should recognize that goats' milk can have as good a flavor quality as cows' milk, although the normal flavor is somewhat different from that of cows' milk. Matthews and Weaver (1928) stated, "Goats' milk produced under sanitary conditions does not have an unpleasant goaty flavor and odor although it does have a flavor different from that of cows' milk." Marquardt (1936) showed that goats' milk high in lactose and low in salt had the best flavor. Trout (1941) stated that:

> "Much adverse criticism without adequate foundation seems to have been made of the flavor of goats' milk, presumably because of the offensive odor associated with the buck during breeding season. The allusion to "goaty" flavored goats' milk by many people seems to be based upon fiction rather than fact. Doubtless several factors affect the flavor of goats' milk much the same as they affect the flavor of cows' milk. However, it must be recognized that production of goat milk from a healthy goat in normal production under proper feed and herd management and sanitation results in a milk which merits no severe flavor criticism. Goats' milk apparently is as capable of possessing a clean, wholesome flavor as cows' milk. On the other hand, it seems to have a distinct, characteristic flavor of its own somewhat different from that of cows' milk."

The report of the Sixth Annual National Goat Milk Scoring Contest, (Dairy Goat Journal, 1941) showed that 90 samples of goats' milk ranged in score from 25, a perfect score for flavor, to 18. Forty-eight or 50.3 percent, of the samples were scored 23.0 or higher, a score usually given at that time for milk flavor above criticism.

GRADING MARKET MILK AT THE RECEIVING PLATFORM

The grading of milk at the receiving platform is the first step of the processor toward insuring a high-quality bottled product, (Figure 25). The daily examination of the milk as it is received

Figure 25 — Examining Milk at the Receiving Platform.

at the plant not only safeguards the milk supply from low-quality, off-flavored milk and hence customer complaints, but also lets the producer know that the milk plant expects and is interested in good milk. Such a routine encourages clean milk production and serves as a constant warning to those producers who may be inclined toward careless methods of producing milk. In plants where strict, daily, milk examinations are made, the visits of the municipal milk inspector or sanitarian are not accompanied by much rejected milk, a disruption of the milk supply and ill feeling on the part of the producers.

Daily receiving platform milk inspection can best be done by a regular attendant of the receiving room. His inspection has certain advantages. He is acquainted with the routes and the hauler and, if not actually acquainted with the producer, is familiar with the patron's number and the usual quantity and quality of milk produced. The regular receiving room milk grader, therefore, knows on which load and by which producers superior and inferior quality milk might be expected.

In daily routine platform examination of market milk, the receiving man might well apply three tests to all milk as an aid in determining quality without appreciably slowing up the weighing, sampling and dumping of the milk. These are: (a) odor, (b) appearance and (c) temperature. Other tests such as (a) taste, (b) strainer, or (c) sediment might be used to substantiate his findings. Tests involving time, laboratory facilities, and special technique are best done by the laboratory technician, the milk inspector or sanitarian. For these purposes, sufficient size samples will be taken as the milk is being received. The results of the laboratory examinations indicate which producers need assistance in improving the quality of the milk. The techniques involved and limitations of the more frequently used platform tests are:

1. Odor. The odor test furnishes an excellent indication of the organoleptic quality of the milk. It can be made very quickly. In making the test remove the cover of each can, invert it, and raise it to the nose (Figure 26). The odor will be representative of that in the can. By replacing the cover and shaking the can vigorously the test may be repeated. Although the odor test may be made of the milk in the can, it is undesirable from the standpoint of public health to breathe over the can. By means of the odor test one can determine with assurance milk which has undergone appreciable bacterial decomposition, that which was produced in poorly ventilated stables, or that resulting from cows having had access to certain flavor producing feeds or to improper feeding and management of the milking herd. Any milk with an off-odor which will lower the quality of the mixed milk should be rejected.

2. Appearance. By regularly observing the milk in each can after the odor test has been made, any off-color, flaky, or partially churned milk may be noted. The presence of any floating

extraneous matter may also be seen. Flaky milk is often indicative of udder trouble. Partially churned milk reflects improper or inadequate cooling and excessive agitation. Such milk contributes to a cream plug on the bottled product which is not desired. Any extraneous matter in milk is objectionable. Floating material in milk such as straw, bits of bedding or insects not only

Figure 26—By Smelling the Milk Film on the Can Lid as Soon as it is Removed, the Odor Quality of the Milk May be Readily Determined.

is highly objectionable, but reflects indifference on the part of the producer toward high quality milk production.

3. *Temperature.* The temperature at which the milk is delivered is often an indication of its quality. The milk ordinance in many cities stipulates that milk shall be at a temperature of 60° F. (15.5° C.) or lower when received from the producer. A daily check on the temperature of the milk is of material aid in grading milk at the receiving platform. With practice, the grader can tell with a high degree of accuracy whether or not the milk is sufficiently cold by placing the palm of the hand against the side of the container. As the hand passes from can to can slight differences in temperature may be detected. Since the conductivity of the metal is high, a temperature of 60° F. (15.5° C.), or lower, definitely gives the sensation of a low temperature. For accurate work a thermometer may be used. However, the use of the thermometer is frowned upon by some health

authorities as it offers a possible source of contamination of the milk. It offers the disadvantage also in that it slows up the dumping of the milk. The rejection of milk because of high temperature will be dependent upon several factors, chief of which will be permissibility of delivering milk such as morning milk without cooling.

4. Sediment. The sediment test of milk need not be made daily, but should be made sufficiently often to assure a clean milk supply. For this purpose a reliable sediment tester, by which the work may be expedited, should be selected. The intensity of discoloration and sediment on the pad will depend to some extent upon the manner by which the test was taken. Some criticize the taking of the sediment test from the bottom of the can rather than from a representative sample. However, the sediment test is made to determine if and to what extent sediment is present. Consequently, any method by which maximum sediment will be revealed should be considered satisfactory. In rejecting milk because of extraneous matter as shown upon the sediment disc it is well to show the producer the sediment disc.

5. Other milk control tests. The milk inspectors who examine milk at the receiving platform at irregular intervals throughout the year often make use of tests which give an indication of the number, type and activity of the bacteria present. For this purpose one or more of the following tests may be made:

a. Methylene blue reduction test.
b. Resazurin test.
c. Fermentation test.
d. Bacteria colony count.
e. Direct microscopic count.
f. Titratable acidity.
g. pH.
h. Alcohol test.
i. Chloride content.

All these tests involve a study of the milk and an interpretation of the findings.

Each test is a study in itself and the one employed will depend upon the information sought, the facilities available and to some extent the personal interests of the inspector. Details.

procedures and interpretations of many of these tests may be found in the "Standard Methods for the Examination of Dairy Products" of the American Public Health Association and in the "Laboratory Manual" of the Milk Industry Foundation.

GRADING MILK FOR PROCESSING OR FOR MANUFACTURE INTO DAIRY PRODUCTS

The first step in controlling the quality of manufactured dairy products is the selection or grading of the milk from which the products are made. Careful grading of manufacturing milk not only is profitable but also necessary if uniformly high quality products are to be obtained. Grading of manufacturing milk is not difficult. However, the grader must know the standards and be able to recognize certain qualities of milk as previously described.

Manufacturing milk is utilized in ways other than as market milk. Thus the immediate chief end-products of manufacturing milk may be (1) market or sweet cream, (2) butter, (3) cheese, (4) condensed and evaporated milk or (5) dried milk. Although the finest quality milk is desired in the manufacture of any of these products, the requirements may vary slightly according to the product manufactured without lowering the quality of the finished product appreciably because of the nature of processing. Thus some quality factors may be conceded when the milk is to be made into certain products. These will be discussed with each specific product.

1. Market or sweet cream. This cream is produced usually in localities not densely populated and shipped to centers of dense population where it is utilized as table or whipping cream, in ice cream, or it may be frozen for later use in ice cream when the supply is short. The milk for this product must be of the highest flavor quality. No developed acidity is tolerated. Low bacteria milk is desired. Essentially, the same quality is required as that intended for bottling purposes.

2. Butter. Milk intended for buttermaking purposes should be of the highest flavor quality, but slight normal feed flavors may be tolerated. Flavors of milk associated with the fat as onion, oxidized and rancid are concentrated in the butter and hence become particularly objectionable. While a slight devel-

opment of acidity may be tolerated in the milk so far as the resulting butter is concerned, difficulty may be encountered in securing high efficiency during separation especially if the milk is heated to a pasteurization temperature. Furthermore, processing and utilization of the skimmed milk may be a problem.

3. Cheese. For cheddar cheese manufacture the milk must meet certain specific requirements. Freedom from dirt and from abnormal fermentation is especially demanded of milk for cheese. Van Slyke and Price (1938) discussing judging milk for cheese-making state in part as follows:

> "In judging milk as to whether it is clean or not, it is necessary to use special means of detecting milk that is abnormal. The following outline of a method is suggested as one that can be made effective for this purpose in connection with cheese-factory milk: Examine the milk (1) for acidity, (2) for dirt in suspension, (3) for the presence of micro-organisms by (a) methylene blue test, (b) curd test, (c) fermentation test, and (4) for flavor. Use the following scale of points for scoring milk:

	When perfect
Methylene blue test .... (Allow 3 points for each hour.)	15
Dirt .... (No dirt in suspension.)	15
Curd test .... (No signs of abnormal ferments.)	45
Flavor .... (Entire freedom from abnormal odor and taste)	25
	100

> "In each milk the score is diminished in the case of each quality if the milk shows any imperfections. This system will be found effective in application, if the judging is done carefully and the results made known to the patrons. If patrons can be persuaded to apply the results of such judging to the distribution of dividends, the work would be more effective, of course. For example, a patron's dividend could be marked down one cent per 100 pounds of milk for each ten points his milk scored below 100 on the above system. Of course, this method does not apply to cases in which the milk is obviously bad when brought to the factory. The only remedy in such cases is to refuse the milk altogether."

The National Cheese Institute recommends a milk intake code and sediment standards for cheese milk as shown in Figures 27 and 28.

This plant operates under the

MILK INTAKE CODE

Recommended by the

NATIONAL CHEESE INSTITUTE, Inc.

1. *Illegal Milk*	Milk classed as illegal under the laws of the state in which this plant operates will not be accepted.
2. *Odor and Flavor*	Every can of milk will be examined for odor and flavor and if found to show pronounced objectionable characteristics will not be accepted.
3. *Sediment*	Each patron's milk will be tested for sediment at least once each week. The bottom-can method of testing will be used as standard. The National Cheese Institute sediment chart will be used as standard.
	All milk showing a sediment pad worse than a No. 3, or evidence of mastitis, or *any* extraneous matter of objectionable character will not be accepted.
	Patrons delivering milk showing a No. 3 sediment pad will be warned at the time of testing.
4. *Milk Cans*	Cans used in transporting milk from farm to plant shall be of such construction as to be easily cleaned and must be clean and in good repair.
5. *New Patrons*	The milk of new patrons must meet the above requirements before being accepted.
6. *Methylene Blue Test*	It is the recommendation of the National Cheese Institute that each producer's milk be subjected to the Methylene Blue reduction test at least semi-monthly.

Figure 27 — Milk Intake Code Recommended by the National Cheese Institute, Inc.

4. *Condensed and evaporated milk.* Fundamentally and basically, the highest quality milk is required for condensed and evaporated milk manufacture. *Freedom from developed acidity*

and sediment are imperative. Abnormal milk resulting from physiological disturbances of the udder is subject to criticism. Since condensed and evaporated milk manufacture involves boiling the milk under reduced pressure all the off-flavors of a volatile nature are driven off in the process. Consequently, some leniency may be shown in grading condensery milk toward off-flavors resulting from absorption, feeds or feeding practices such as barny, silage, alfalfa, rye pasture or even slight onion. On the other hand, no tolerance should be given milk having any off-flavors as a result of bacterial or chemical decomposition.

5. *Dried milk.* As with condensery milk, it is undesirable to have sediment or developed acidity in the milk to be used in dry milk manufacture. Some leniency may be shown, however, toward non-bacterial, volatile-flavored milk.

FACTORS TO BE CONSIDERED IN GRADING MILK TO BE MANUFACTURED INTO DAIRY PRODUCTS

1. *The container.* The appearance of the container often will give an indication of milk contained therein. The cans should be bright, clean, well-tinned and reasonably free from dirt collected in transit. Old, dented, poorly tinned cans jeopardize the quality of milk and low quality milk may be found in them. Milk in cans in bad physical and sanitary condition should be examined carefully for quality. Since the milk is to be used for human consumption it should be delivered in clean, sanitary containers.

2. *Temperature.* Milk that has not been properly cooled or maintained at a low temperature deteriorates rapidly in quality. The temperature of the milk should be checked by placing the hand on the container. If the container is cold, the acidity of the milk in it will probably be satisfactory. If the container is warm the acidity may have increased to the point where the milk will not be satisfactory for processing. Manufacturing milk should be subject to requirements as to temperature the same as market milk.

3. *Age.* The quality of milk is best when it is fresh. Milk should be delivered within a reasonable time after it is produced. This is especially true during the warm, summer months. Sometimes, during the cool months, when production is low, milk is delivered every second day and is known as "two-day" milk. Such milk is subject to more defects than milk delivered every

day. Milk should be carefully examined for possible defects if it is not delivered reasonably early on the day it is to be processed.

4. *Acidity.* The acidity of fresh milk when drawn will range widely, but may be expected to be from 0.14 to 0.20 percent, calculated as lactic acid. This is known as "apparent" or "initial" acidity and has little influence on the quality of the products made from it. Acid that is formed in milk as a result of bacterial growth, changing the lactose to lactic acid, is known as "developed" or "real" acidity. "Developed" or "real" acidity formed in any appreciable amount is detrimental to the quality of the products made from it. This acidity can be detected easily by the sense of smell even though only a small amount has been formed. Milk having developed acidity present should be accepted only with extreme caution, as such milk does not lend itself well to the manufacture into products of satisfactory quality. Milk having a titratable acidity over 0.20 percent is generally looked upon with suspicion.

5. *Bacteria.* No system of grading milk would seem to be complete without having considered at least the relative bacteria count of the milk. The age of the milk, the titratable acidity and the flavor give some indication of the bacterial quality of the milk. However, by the time the titratable acidity and the flavor are affected by bacterial growth the bacteria count is well into the millions.

The relative bacteria count of milk may be determined by one of several methods depending upon the specific information sought. The methylene blue reduction method offers several advantages in classifying milk according to the relative bacterial count when the milk is to be used for manufacturing purposes. The American Public Health Association (1941) now recognizes higher methylene blue standards for market milk than those generally specified. The following commonly used standards seem to apply well to the classification of manufacturing milk:

Class	Quality of Milk	Time of decoloration
1	Good	Over 5½ hours
2	Fair, average	2-5½ hours
3	Unsatisfactory objectionable	20 min. to 2 hours
4	Very unsatisfactory, very objectionable	Less than 20 minutes

6. *Sediment.* The sediment of milk must be considered in grading manufacturing milk particularly when products such as cheese, condensed and evaporated milk and dried milk are to be made from it. The methods of examining milk for sediment have been previously described. The sediment standards for cheese milk are shown in Figure 28.

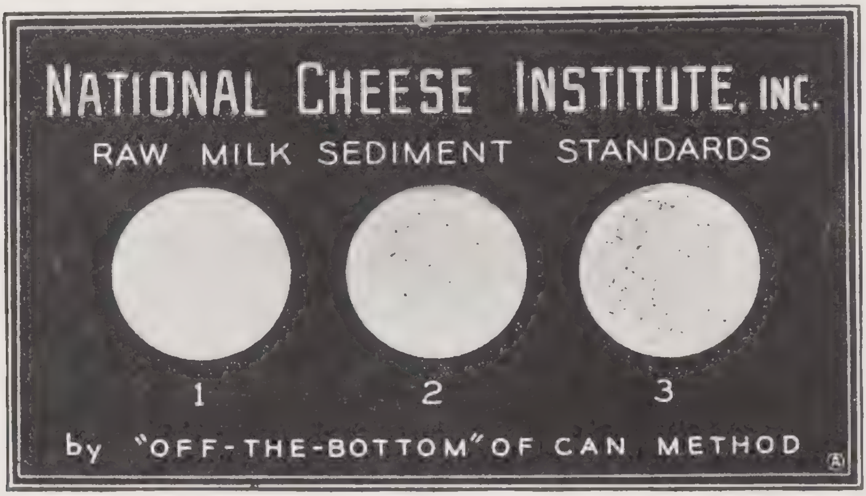

Figure 28 — Standards for Sediment in Raw Milk Intended for the Manufacture of Cheese. (Courtesy National Cheese Institute, Inc.)

7. *Flavor.* Although the container, the temperature, the age and the acidity often furnish good indications of the quality of the milk, the separation of the milk into grades must be done finally by carefully examining the milk for flavor. The technique for ascertaining the flavor of milk has already been fully described. The off-flavors which may be tolerated in the various grades are grouped under the discussion of the grades.

GRADES OF MANUFACTURING MILK

While the authors believe there should be a single minimum standard of quality for all milk whether it is to be used directly as fluid milk or for the manufacture of the various dairy products, they realize that at present several grades do exist and some grading seems necessary. A grading system that is relatively simple and divides the milk into three classes where it can be used to the best advantage may be employed as follows:

Grade I. Milk with a clean, pleasant flavor (methylene blue reduction time over 5½ hours) and which shows practically no soiling of the sediment disc, shall be Grade I milk. Tolerance should be shown for such off-flavors as slightly

feed, flat or salty and for a few specks on the sediment disc. The sediment score using the United States Department of Agriculture sediment chart shall be 9.0 or above.

Grade II. Milk having off-flavors such as definitely feed, flat, or salt, slightly barny, bitter, foreign, malty, metallic, musty, oxidized or rancid, or very slightly weedy (a methylene blue reduction time between 2½ and 5½ hours) or shows a medium amount of sediment shall be Grade II milk. The rating of sediment shall be 7.0 or above.

Grade III. Milk having off-flavors such as definitely barny, bitter, foreign, malty, metallic, musty, oxidized or rancid, or slightly high-acid (a methylene blue reduction time between 20 minutes and 2½ hours) or is definitely high in sediment shall be Grade III milk. The sediment score shall be 5.0 or above.

Reject or no grade. Milk having pronouncedly high-acid, rancid, weedy, or foreign flavors (a methylene reduction time of less than 20 minutes) and containing an extremely high amount of sediment or any obnoxious foreign matter shall be given NO GRADE and shall be rejected as it is unfit for processing into human food. The sediment score shall be below 5.0.

The specific off-flavor intensity permitted in each grade of milk is given in Table 8. The use made of each grade of milk will depend upon public health regulations concerning conditions of production and upon the specific character of the product. In general, Grade I milk may be used for market milk (public

Table 8—The Flavor Defect Intensities Allowed in Each Grade of Manufacturing Milk

	Intensity of flavor defect tolerated in			
Flavor defect	Grade I	Grade II	Grade III	No Grade
Barny, cowy, unclean		slightly	definitely	
Bitter, rancid		slightly	definitely	pronouncedly
Feed	slightly	definitely		
Flat	slightly	definitely		
Foreign, disinfectant		slightly	definitely	pronouncedly
High-acid			slightly	pronouncedly
Malty		slightly	definitely	
Metallic, oxidized		slightly	definitely	
Musty		slightly	definitely	
Salty	slightly	definitely		
Weedy		very slightly	slightly	pronouncedly

health requirements permitting) or in the manufacture of any high-quality dairy product; Grade II for butter, or if comparatively free of sediment, for cheese or concentrated milk; and Grade III only for butter. Since milk is centrifuged for butter-making purposes, the presence of sediment in Grade III milk will not be present in the final product. Also, some developed acidity may be tolerated in milk intended for butter, provided the milk can be efficiently separated. No stigma is placed upon butter by the utilization of Grade III milk in its manufacture.

USE OF CHARTS IN RESEARCH STUDIES ON MILK FLAVORS

In order to secure greater uniformity in evaluating milk flavors by several judges, research workers sometimes find it to advantage to make use of a chart. Such a chart has been devised and used effectively by Fouts and Weaver (1935). The chart used by them is presented in Table 9. The benefits derived by them in using this chart were:

a. Contributed to the unification of the scores accorded by individual judges.
b. Opinions of individual judges were believed preferable to a flavor evaluation resulting from a conference of the judges.
c. Provided an incentive for the judges to score inferior milk sufficiently low to differentiate effectively from superior milk.
d. Fortified one's vocabulary.
e. Afforded some guidance as to the seriousness of the various flavor defects in milk.
f. Conducive to "flavor consciousness" among dairy workers.
g. Depicted graphically flavor information desired by dairy workers.
h. Proved an asset in giving instruction in milk judging.

The chart is based on a perfect flavor score of 25 which was the evaluation of flavor on the official milk score card at that time. Concerning the chart and its use they state in part:

> "In the chart are included the five classes into which milk is divided on a basis of flavor as suggested by Babcock and Leete. The perfect score for flavor is 25*. Milk that scores 23 or above, is designated as excellent, 21 or 22 good, 18, 19 or 20 fair, 12 to 17 inclusive poor, and 11 or

*Flavor score given was based on the score card previously used.

Table 9 — Flavor Defects and Suggested Scores
(Fouts and Weaver, 1935)
(s. indicates slight; v. indicates very)

Class	Excellent	Good	Fair	Poor	Bad
Scores	23 and above	21 and 22	18, 19 and 20	12 to 17, incl.	11 and below
Acid	......	....	....	s. acid	acid v. acid
Bitter	......	....	....	s. bitter and bitter	v. bitter
Cooked	......	s. cooked s. cowy	cooked cowy	v. cooked v. cowy	....
Disinfectant	......	....	....	s. disinfectant	disinfectant and v. disinfectant
Feed	......	s. feed	feed	v. feed	....
Flat	......	s. flat	flat	v. flat	....
Metallic	......	....	s. metallic	metallic and v. metallic	....
Musty	......	....	....	s. musty	musty and v. musty
Nutty	......	....	s. nutty	nutty and v. nutty	....
Oxidized	......	....	s. oxidized	oxidized and v. oxidized	....
Rancid	......	....	....	s. rancid	rancid and v. rancid
Salty	......	....	s. salty	salty	v. salty
Sharp	......	s. sharp	sharp	v. sharp	....
Stale	......	....	s. stale	stale and v. stale	....
Sweet	......	s. sweet and sweet	v. sweet	....	....
Watered	......	....	s. watered	watered and v. watered	....
Weedy	......	....	....	s. weedy	weedy and v. weedy

below is bad. A fractional score in no case serves to raise a sample into a higher class than it would enter without the fraction. For instance, a sample scoring 20½ is classed as fair, not as good. Eighteen different defects in flavor are enumerated. It is recognized that some of these are subject to challenge. Again some judges would choose to add other terms. In a year's work with this chart, during which time about 1,000 milk samples have been scored by five or six judges, a few suspected off-flavors other than the eighteen enumerated have been encountered. However, none of these other flavors have been observed with enough certainty or frequency to justify its inclusion in the chart.

"In formulating this chart it was believed each flavor could be resolved into at least three degrees of intensity.

> Accordingly the terms ‘slight’ and ‘very’ are employed to reveal the upper and lower gradations in the flavor. These terms, or comparable ones, are used by all judges. The effort in the chart is to ascribe some numerical significance to the different gradations.
>
> “It is observed in several cases here that two gradations of a given flavor are suggested under the same class. For instance, milk that is either ‘acid’ or ‘very acid’ is classed as *bad*. Again, milk that is ‘slightly bitter’ is held down into the same class as ‘bitter’ milk. In devising the chart decisions that relegated the different flavor gradations into the various classes were based on experience and usual practice in scoring milk. They are entirely arbitrary and no effort is made here to defend them. On the whole, however, it is believed few workers would have occasion to deviate greatly from the suggestions as given.
>
> “Frequently in using this chart the judges have found occasions which prompted them to use an additional gradation to reveal a ‘very slight’ intensity in some flavor. Such occasions have arisen most frequently with the salty samples. It is suggested in the chart that milk found to be ‘slightly’ salt should be classed as *fair*. However, the judges sometimes detected a very slight taste of salt that was in no wise objectionable. They felt it was unduly critical to hold the milk down to *fair* so used the gradation ‘very slight’ salt and kept the milk in the *good* class.”

Thus it appears that the use of such a chart based upon the present milk score card would be extremely helpful in studying milk flavor. Particularly in milk research, would flavor data then be put on a common basis involving use of a uniform specific flavor nomenclature and evaluation.

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Review Questions

1. Distinguish between household or market milk and manufacturing milk.
2. Give the United States Public Health Service definition of milk.
3. Compare the bacteria standards for certified, grade A and grade B raw milk with those for grade A and grade B pasteurized milk.
4. How may vitamin D milk be produced?
5. What specific flavor defect may be associated with irradiated milk?
6. What is homogenized milk?
7. What defects are particularly associated with homogenized milk?
8. Define soft-curd milk.
9. Indicate at least five ways by which soft-curd milk may be obtained.
10. From what may reconstituted milk be made?
11. List in order the various steps in the routine of scoring milk.
12. When is a milk bottle considered full?
13. When is a container closure sealed?
14. Under what conditions is the item of temperature considered in scoring milk?

15. What advantages does the sediment disc method of scoring sediment have over the observation of sediment in the bottom of the bottle?
16. When may deductions of one-tenth (0.1), twenty-five hundredths (0.25), five-tenths (0.5) and whole points (1.0) be made in scoring sediment?
17. What is perhaps the most common off-flavor noted in market milk?
18. Give the flavor classes of milk with approximate score of each.
19. Distinguish between "cooked" and "heated" flavors of milk.
20. List the flavors of milk which may be noted by the sense of taste only.
21. Define chocolate milk.
22. List the possible defects in appearance and color of chocolate milk.
23. Why is sediment in chocolate milk objectionable?
24. What items are considered particularly in judging skim-milk?
25. Compare the flavor of goats' milk with that of cows' milk.
26. Who may best make the daily platform inspection of market milk?
27. What items should be considered regularly in grading market milk at the receiving platform?
28. What defects are particularly undesirable in milk intended for cheddar cheese manufacture?
29. What defects are particularly objectionable in milk intended for condensed and evaporated milk?
30. Compare the grades of manufacturing milk.
31. Under what conditions may manufacturing milk be classed as "Reject or No Grade"?

CHAPTER VI

JUDGING AND GRADING BUTTER

Butter is generally marketed wholesale according to its score or grade. In some states butter is also retailed according to grade. These grades are placed on the butter by competent judges who make a detailed organoleptic examination of it. Although demands for flavor, body and texture, degrees of saltiness, shades of color and styles of package may vary somewhat in different sections of the country, the basis of evaluating, scoring or judging butter remains fairly uniform from one section to another.

A good judge is thoroughly familiar with butter and has a wealth of information concerning it at his command. He knows the score card, the kinds, classes, scores, grades and defects encountered in butter and the tolerances allowed. In order to judge butter intelligently, the beginner, likewise, should become familiar with the component parts of the score card, the kinds and classification of butter and the desired flavor, body and texture, color, salt and package qualities of the product. He should also familiarize himself with the possible defects in butter so that he might recognize them readily and evaluate them correctly when encountered.

Kinds of Butter

Many kinds of butter are to be found on the market. These vary with the type of cream from which the butter is made and with variations in the manufacturing process. Unless specifically stated, the various kinds of butter may or may not have been salted. Generally, butter may be grouped as follows:

1. *Pasteurized-cream,* or *unpasteurized-cream* butter.
2. *Ripened-cream,* or *unripened-cream* butter.
3. *Salted,* or *unsalted* butter.
4. *Sweet-cream,* or *sour-cream* butter.
5. *Fresh,* or *storage* butter.
6. *Dairy,* or *creamery* butter.

Pasteurized-cream butter. Pasteurized-cream butter is that made either from pasteurized sweet cream or from pasteurized

sour cream. Such butter usually has a milder flavor than butter made from similar cream not pasteurized. The flavors are often less pronounced in intensity than those noted in raw-cream butter and are not so extensive in number.

Unpasteurized- or raw-cream butter. Raw-cream butter is that churned either from unpasteurized sweet, or from unpasteurized sour cream. The flavors present are very similar to those common to raw cream. In addition, such flavors commonly referred to as "strong," but more accurately described as "rancid" or "bitter," often develop in raw-cream butter, particularly when the butter is made from cream produced during winter season conditions.

Ripened-cream butter. Ripened-cream butter is that made either from sweet, or from sour cream in which a pleasant, delicate aroma has been developed before churning by inoculating the cream with a butter culture and holding the cream at a desired temperature. Ripened-cream butter can usually be distinguished by its volume of aroma, which is generally somewhat lacking in unripened-cream butter. Properly made, ripened-cream butter has a delicate flavor which is sometimes referred to as a "real butter flavor." Some culture butter is made by adding butter culture or butter-culture distillate to the butter at time of salting and working it directly into the butter.

Unripened-cream butter. Unripened-cream butter is that made either from pasteurized sweet cream or from pasteurized sour cream to which no culture has been added. The flavor of unripened-cream butter is usually mild. Frequently, the inexperienced judge will criticize a sample of unripened-cream butter as "flat" or "lacking aroma."

Salted butter. Salted butter is that to which salt has been added. The flavor of salted butter usually is more pronounced than that of unsalted butter.

Unsalted butter. Unsalted butter is that which contains no added salt. The flavor of such butter is very noticeable and is frequently criticized by the inexperienced judge as "flat." This type of butter is often referred to as "sweet" butter. "Sweet" butter may or may not have been made from sweet cream.

Sweet-cream butter. Butter obtained from the churning of cream, the acidity of which has not exceeded 0.20 percent, cal-

culated as lactic acid, is called sweet-cream butter. The cream may or may not have been pasteurized.

Sour-cream butter. Sour-cream butter is made from cream the acidity of which has exceeded 0.20 percent, calculated as lactic acid. The acidity may have been standardized to conform approximately to that of sweet cream. The cream may or may not have been pasteurized.

Fresh butter. Fresh butter is that which has not undergone cold storage. Usually, fresh butter does not exceed three weeks of age.

Cold-storage butter. Cold-storage butter is that which has been stored at a temperature of about 0° F. (−17.7° C.) for a period of time. Generally, cold-storage butter is from one to six months old when offered to the retail trade.

Dairy butter. Dairy butter is that made on a farm. It is usually made from unpasteurized sour cream which has not been standardized for acidity. This butter generally has a high flavor due to the high acid content of the cream. Lack of uniformity between samples is apparent even when produced on the same farm. Due to the lack of proper equipment and conditions for making it, dairy butter often exhibits very noticeable body and texture, color, and salt defects.

Creamery butter. Creamery butter is made in a creamery or factory. It is generally made either from pasteurized sweet cream or from pasteurized sour cream. Creamery butter is more uniform in flavor and in workmanship than dairy butter. Nearly all butter sold commercially is creamery butter.

Quality Classes of Butter

The judging of butter is generally limited to dairy butter and creamery butter. Dairy butter is not generally sold on grade but there are times when it is exhibited for prizes at dairy products shows. Creamery butter sold on the wholesale terminal markets is usually sold on grade. Therefore, it is necessary to score it to determine the grade. The scores of commercial butter range from 93 points for the highest grade, known as "AA," down to 89, designated as "C" grade. Creamery butter exhibited at dairy products' shows and educational exhibits where the buttermakers test their skill in making butter of excellent flavor and workmanship usually scores much higher than com-

mercial creamery butter. Scores of 95 points are not uncommon for exhibition butter and occasionally a score of 96 has been given to very excellent butter when a large number of samples of very fine butter are exhibited in extremely keen competition. Butter scoring within certain ranges may be referred to under one of the various terms which are described briefly as follows:

"Shakes." "Shakes" or "shake down" is a term applied by judges to samples of butter of very excellent quality, usually meriting a score of 94 points or above. The definite scores of these samples are determined by careful comparison after all the other samples in the exhibit have been judged. The winners of the high awards in the contest are determined from the "shakes." This butter scores above any of the established market grades recognized at the present time.

Specials. "Specials" is a market term which refers to fine flavored butter that scores 93 points or above. Terminal wholesale markets usually recognize a 93-score butter as "specials." This grade of butter is also referred to as "higher scoring."

Extras. "Extras" refers to a 92-score butter. The flavor must be clean and the body and texture, color and salt free of any pronounced defects.

Firsts. The grade of butter below "extras" is known as "firsts." The scores may range from 91 down to 88 points. Reference is sometimes given to "high firsts," "medium firsts," or "low firsts."

Standards. Centralized carlots of butter manufactured in one plant and scoring 90 points or higher are sometimes referred to as "standards."

Lower scoring lots. Formerly butter scoring 87 points or lower was called "seconds." The term "thirds" formerly referred to butter scoring below 84 points. At the present time, the United States butter grades classify lower scoring lots, 88 down to 86 points, as "Cooking Grade." Butter scoring below cooking grade is classified as "No Grade" by the federal butter graders.

In January, 1943, the United States Department of Agriculture revised the standards for creamery butter, effective February 1, 1943. The revised standards provide for letter grades instead of numerical grades. The relationship of the revised standards to the former grades is presented in Table 10.

The standards for the different U. S. grades of butter are given in the Appendix.

Table 10 — The General Relationship Between Descriptive Terms, Numerical Scores, and Letter Grades of Creamery Butter

Descriptive term	Numerical score*	Letter grades**
"Shakes"	Above 93	No grade designation
Specials	93	AA
Extras	92	A
High or extra firsts	91	B
Standards (carlots from one creamery)	90	B
Firsts	89	C
Low firsts	88	
High seconds	87	CG (Cooking Grade)
Medium seconds	86	
Low seconds	85 or below	"No grade"***

*Handbook of Official United States Standards for Quality of Creamery Butter. U. S. Dept. Agr., Agr. Marketing Service, February, 1940. Effective April 1, 1939.

**Official United States Standards for Grades of Creamery Butter. U. S. Dept. Agr., Food Dist. Adm., January, 1943.

***"No grade — Butter that possesses any of the following flavors or contains any of the following substances listed under 'Conditions,' or is below the requirements of the U. S. Cooking Grade, shall be classified as 'No Grade.' Flavors: Pronouncedly fishy, surface taint, limburger, tallowy, rancid, paint or varnish, gasoline, kerosene or fly spray, chemical. Conditions: Mold, grains of sand, splinters of wood, specks of rust, other foreign materials."

Butter Scoring

The butter score card. The score card serves as a guide in determining the quality of butter. By comparing the flavor, body and texture, color, salt and package qualities of a sample with the values given those factors on the butter score card, the numerical quality of the butter is determined. For this purpose the butter score card approved by the American Dairy Science Association is used. The experienced judge is thoroughly familiar with this score card. The beginner should study the items which make up the score card, the relative value of each and how each factor is determined.

Condition of the judging room. The room in which butter is scored should be clean and well-ventilated. The temperature of the room should be about 60° F. (15.5° C.). There should be no foreign odors either within the room or nearby. The use of tobacco in any form should be prohibited in the judging room at all times. Tobacco odors are very penetrating. Although the room may be aired out the tobacco odors can be detected as soon as the room is closed again for a few hours. There should be plenty of light so that the uniformity and shade of color can be

readily determined. Daylight is superior to electric light for the inspection of color.

Tempering the butter. The delicate aroma of butter is more readily detected and the body and texture characteristics are more easily determined when the butter is at the right temperature for judging. Butter stored in a refrigerator that is colder than the correct temperature for judging, which is approximately 60° F. (15.5° C.), should be put into the judging room a sufficient time in advance of judging so as to bring it to the correct temperature. This is commonly referred to as "tempering" the butter. The lower the temperature at which the butter is stored, the longer the time required in the judging room to bring it to the scoring temperature. The time required also depends on the size of the package and the temperature of the previous storage room. One-pound prints will temper in a relatively short time, while 63-pound tubs or 68-pound cubes require a much longer time. One to two hours at 65° to 70° F. (18.3°-21.1° C.) is generally sufficient for one-pound prints, while the larger tubs and cubes take much longer. An overnight tempering period for the tubs and cubes should prove very satisfactory.

The Butter Score Card

Factors	Perfect Score
Flavor	45
Body and texture	25
Color	15
Salt	10
Package	5
Total	100

Use of the butter trier. The sample is taken by a long, two-edged, curve-bladed knife known as a trier (Figure 29). Facilities for cleaning the trier and disposal of the waste butter should be provided. The trier should not be washed in warm water but should be wiped with soft tissue or absorbent paper. Washing

the trier in warm water will warm it sufficiently so that it will yield a melted, greasy surface on the following plug of butter taken, which obscures the true condition of the body and texture and makes observation of the color difficult. Low grade, unfolded, twelve by twelve-inch white paper napkins are a very

Figure 29 — Kinds of Triers Used in Sampling Butter and Cheese.

good and economical material for wiping triers. These napkins are sold wrapped 1,000 in a package. By cutting them crosswise in a paper cutter, 4,000 trier wipers six inches square can be made. Each small packet will then have a covering on two sides, top and bottom, which will keep them clean. If a clamp is put on the covered corner it will hold them firmly and avoid scattering if air is circulated through the room. An old bucket, used butter tubs or cubes, are suitable for the disposal of the used sample, the paper used to wipe the trier, and for expectorating.

Taking the sample. Since the hands will come in contact with the butter more or less during sampling, they should be thoroughly washed before judging. Remove the coat to permit easy movement of the arms. Put on a white frock, or apron, to protect the clothes. Clean the trier by wiping it with soft tissue or

absorbent paper. Record the number of the sample on the score card and begin scoring. Stand squarely in front of the sample and observe the cleanliness and neatness of the package. Turn it around and notice if this appearance is carried throughout. Remove the cover and, in the case of tubs or cubes, observe the evenness of the liner and in the case of prints, observe the

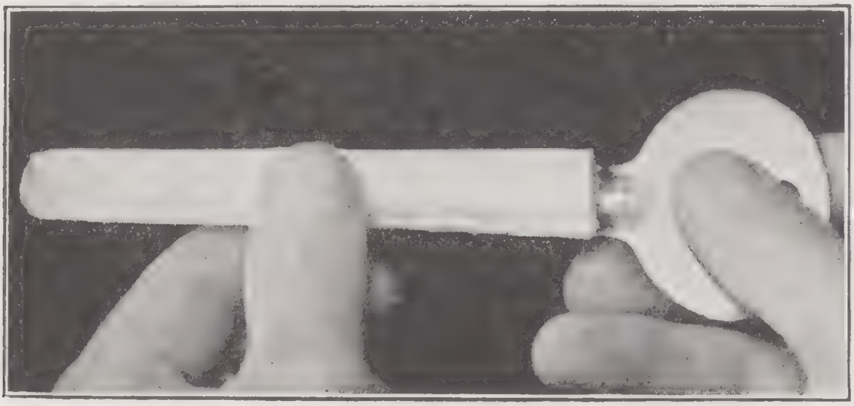


Figure 30 — By Pressing the Plug of Butter With the Thumb Waxiness and Leakiness May Be Determined.

squareness of wrapping. Get a mental picture of your observations.

Next, grasp the butter trier firmly in the hand, insert it diagonally near the center of the butter, turn it one-half around, and withdraw the plug.

Sequence of observation. *Immediately* after withdrawing the plug, and before making any color observations, pass the trier of butter slowly under the nose, inhale through the nose very slowly and notice the odor or aroma present. Make a mental record of this odor or aroma. After observing the aroma present, examine the color for uniformity throughout. Next examine the body and texture by pressing the ball of the thumb against the sides of the plug until it shows a break (Figure 30). Notice the presence or absence of free moisture or "beads" of water and their clearness (Figures 31 and 32), and also the nature of the break; that is, whether it is smooth or jagged.

The scoring so far has been done largely by the sense of sight. Now the senses of smell and of taste will be brought into action. Break off a full inch at the end of the plug, representing the center of the butter being scored, and put it into the mouth. Chew it until melted, then roll the melted butter about in the

mouth until it becomes of body temperature. Meanwhile, feel between the teeth for the presence of "grit," which is undissolved salt, and feel the manner in which the butter melts. Notice also the various sensations of taste and of smell. Just before expectorating the melted butter, roll it to the back roof of the mouth to detect the palate flavors. Expectorate the sample,

Figure 31 — Butter With a Leaky Body Usually Shows Free Moisture on the Back of the Trier.

Figure 32 — Butter With a Waxy Body. Note the Dry Trier.

observe the aftertaste, and note whether or not the flavors persist. The actual physical scoring is now complete. Record your findings on the butter score card previously marked for that sample and make your evaluations. Record what you actually find. Be especially careful to avoid imagining a flavor which does not exist. Many an amateur judge has lost a judging contest because he was not true to his convictions.

SPECIFIC REQUIREMENTS OF HIGH GRADE BUTTER

The requirements of good butter, together with the defects encountered, are discussed under the items on the score card. In this discussion the score card is reversed. The items with the lower ratings are discussed first. The scoring of these items is done largely by the senses of sight and touch, which are fairly easily developed; consequently, by reversing the order of scoring, thereby scoring first those items which can be seen or felt, the beginner as he proceeds becomes more confident in his ability to judge.

This technique of scoring butter cannot be over-emphasized, because it enables the beginner to make the most efficient use of his time, trains him to think, to concentrate, and to organize his work.

Scoring Package

Package — 5 points

The package in which butter is sold should, above all, be neat, clean, and tidy in appearance, showing good finish. This is true regardless of the type of package, whether it is a one-pound print, a five-pound carton, a tub, or a cube. Finger prints should not be in evidence, either on the wrapper or on the tub. The tub or carton should appear fresh and unsoiled, as if it had not been in previous service. The lid should be fastened firmly and neatly. When the lid is removed, the inner lining should give the appearance of neatness and reflect a pride in workmanship. In the case of 1-pound prints, the removal of the carton should show a uniform, neatly wrapped print.

In order to encourage buttermakers to put butter on the market in neat, well-prepared containers, the package is generally considered in all educational butter exhibits. Usually the package is allowed the full five points or a perfect score. When the tub, cube or print is soiled, which is obviously the fault of the

buttermaker, a deduction of one-half point is made on this item. If the package is definitely soiled and untidy a full point may be deducted, which allows only four points on package rather than five.

In grading butter, the federal butter graders do not consider package as a factor in determining the market grade of the butter. The federal graders consider that the package is not a constituent part of the product and has no direct influence on the market quality of the butter.

Scoring Salt

Salt — 10 points

Individuals differ in their preference of amount of salt in butter. Some prefer a highly salted butter, some desire a lightly salted butter, while others use unsalted butter entirely. Different markets demand widely varying percentages of salt. The same score card, however, must be used in scoring butter having a wide range in percentage of salt. *Whether the butter is high or low in salt or even unsalted, providing the salt is all dissolved and not too sharp, salt is given the perfect score of ten points.*

The butter should be examined for undissolved salt when it is first put into the mouth; otherwise the salt will soon go into solution with the saliva and, therefore, cannot be detected. The presence of "grittiness" or "grit," which is undissolved salt, can be detected most easily by placing some butter between the molars and pressing them together very lightly. If undissolved salt is present, the gritty effect will be noticed at once. Undissolved salt on the surface or wrapper of an exposed sample does not indicate the presence of a gritty condition in the butter. If butter is not worked sufficiently there may be water droplets containing salt on the surface. The water will evaporate, leaving the salt in the form of white crystals on the surface of the butter. In order to merit a perfect score, *the salt in the interior of the butter must be dissolved.* A sharp, salty condition usually indicates excessive salt in the butter, particularly when the butter is well worked as indicated by the freedom from water droplets on the trier. If the salt is slightly sharp one-half point is deducted. When the salt is definitely sharp a whole point is deducted. Gritty salt is a more serious defect. If the salt is slightly gritty, one point is deducted, but if it is definitely

gritty two points are deducted. In the majority of cases the deduction made for grittiness does not exceed one point. The normal range of score on salt is from nine to ten.

Scoring Color

Color — 15 points

Just as the degree of salt varies with the market, so does color. In some sections a moderately high color is preferred, while in other sections a light color is more desirable. *The uniform light straw color seems to meet best with the demand of the American people.* However, the shade of color is of little consequence in scoring, providing the color is a natural shade of yellow commonly associated with milk fat and not higher than the natural color of butter produced when the cows are on full grass pasture. Greenish-yellows or reddish-yellows are discriminated against. *The chief point to observe in scoring butter for color is the uniformity of color throughout.*

The butter judge should be aware of the following possible color defects in butter:

1. Black, green, red, white or yellow specks
2. Bleached, dull, pale, lifeless
3. Faded surface
4. High-colored surface
5. Lack of uniformity between churnings
6. Mold discoloration
7. Mottles
8. Streaks
9. Unevenness
10. Waviness

If the color is a natural shade of yellow, not excessively high, and shows uniformity throughout the entire sample, the perfect score of 15 points is allowed. When the color is mottled, wavy, streaked, specked, or too high, deductions are made depending on the seriousness of the defect. Of all these defects, a mottled color is generally the most serious because it usually indicates the presence of buttermilk resulting from insufficient washing or incomplete incorporation of the salt (Figure 33). Streaky butter is less serious than specked butter, yet more so than wavy butter. The former generally denotes too little working, while the latter indicates either the incomplete mixing of two butters having a

different shade of color or uneven working of the butter. Highly colored butter is discriminated against chiefly on its artificial appearance.

Color defects in butter can very largely be eliminated by proper working. The flavor of poorly worked butter is not as

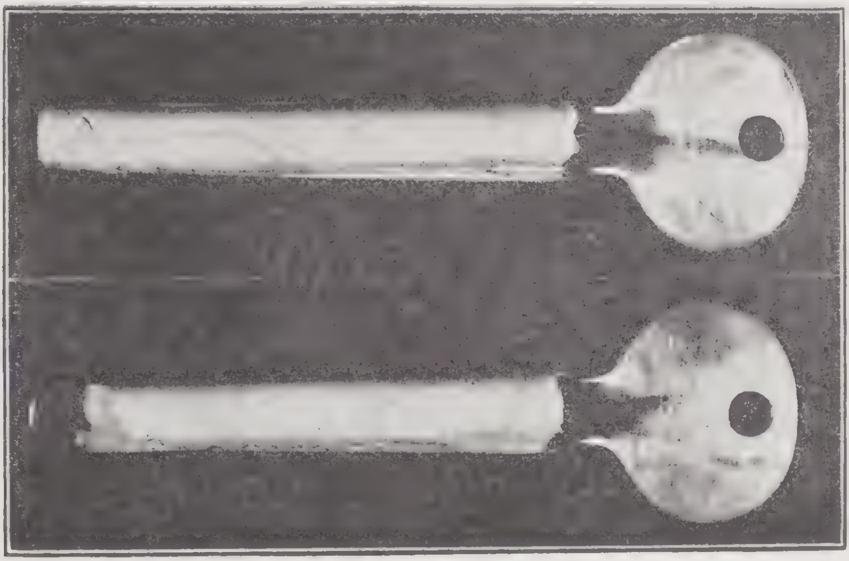


Figure 33 — Mottled and Wavy Butter.

good as the flavor of the same butter would have been if it were well worked. Furthermore, butter with color defects due to insufficient working usually does not keep as well as butter that is adequately worked. Therefore, a color defect may be a hint to the judge to be on the alert for a possible flavor defect.

One-half point is deducted for slightly wavy or for slight color specks and a whole point if these color defects are definite For slight streaks or slight mottles one point is deducted and two points if either of these defects is present to a definite degree A pronounced high (unnatural) color merits a deduction of one point. The normal range of score on color is from 13 to 15.

Scoring Body and Texture

Body and Texture — 25 points

Immediately after examining the trierful of butter for aroma and color, the body should be inspected before it is affected by exposure to the higher temperature. Notice the outside of the plug for the presence of "beads" of water, for smoothness, for solidity, and for firmness. Press the ball of the thumb against

the outside and notice how it breaks. If beads of water appear, notice if this water is clear or milky. The milky appearance often furnishes a clue to the flavor present. By means of a spatula or knife, cut off a small piece of the plug and place it in the mouth, noting how it melts, and if the physical presence of it seems to disappear. The butter should melt evenly and disappear slowly. Get the feel of the sample with the tongue and the palate, as it is melting. *The body of butter should be firm, showing a waxy, close-knit texture.* When broken, the butter should present a jagged, irregular, broken wrought-iron-like surface (Figure 34). Due to improved workmanship, cream-

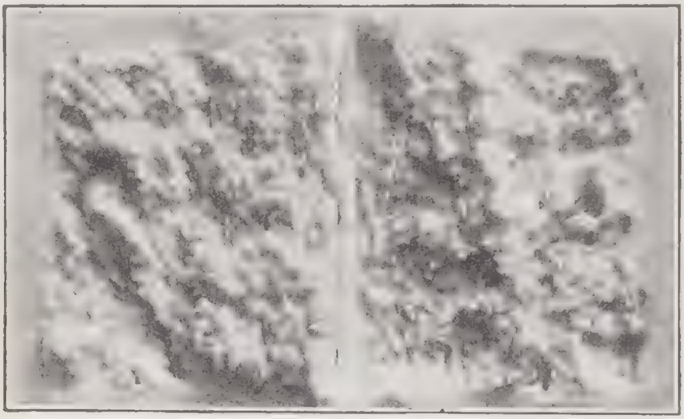


Figure 34 — Butter With a Desired Texture Exhibits a Close-Knit, Broken Wrought-Iron Appearance When Broken.

ery butter generally scores perfect in body and texture. In other words, the deductions for body and texture defects seem to be the exception rather than the rule, which means that the body and texture are generally given the full score of 25 points. Dairy butter is much more likely to have body and texture defects than creamery butter due to inadequate working equipment and manufacturing facilities on the farm. The normal range of score on body and texture of butter is 23 to 25.

Body and Texture Defects of Butter and Their General Causes

Body and texture refers chiefly to the physical properties of butter. These physical properties depend upon the composition of the butterfat, structure of the fat globules, rate of fat crystallization in cream and butter, amount of liquid fat and the size of the fat crystals in the butter. Although body refers to the general make-up of the mass, and texture to the arrangement of

the particles that make up the mass, they are so closely related that they are not considered separately in judging the physical properties of butter. The major body and texture defects are (1) crumbly, (2) gummy, (3) leaky, (4) mealy or grainy, (5) ragged-boring, (6) spongy or weak, and (7) sticky.

1. Crumbly. The fat particles in a crumbly or "brittle"-textured butter lack cohesion and do not stick together. Some of it usually adheres to the trier, leaving a rough appearance. As the name suggests, the butter appears dry and readily falls to pieces rather than breaking when pressure is applied to the plug. The crumbly texture of the butter suggests that it has been underworked; however, if it is worked more the body becomes sticky. Restaurant and hotel trade especially discriminate against this kind of butter because it is difficult to cut into regular serving squares and does not have good spreadability.

Crumbly texture is usually observed during the late fall and winter months. It seems to occur more frequently in the butter-producing sections where alfalfa hay is the predominant roughage fed to dairy cows, which indicates that the composition of the butterfat may be one of the factors involved. The temperature to which the cream is cooled after pasteurization, the length of the holding period, the churning and the wash water temperatures are factors to be considered in overcoming this texture defect. The sudden chilling to extremely low temperatures immediately after churning may also cause crumbly or brittle-textured butter. One-half point is deducted for a slightly crumbly texture and a whole point when the texture is definitely crumbly.

2. Gummy. Gummy-bodied butter sticks to the roof of the mouth and gives a gum-like impression. This defect is more prevalent in sections where cottonseed products are fed as the protein supplement in the dairy ration. Likewise, the defect is more prevalent during the winter months. Probably cottonseed products are fed more extensively during that season. The gumminess is thought to be due to the abnormally firm condition of the butterfat, which in turn is due to the high percentage of high-melting-point glycerides. The hardness of the butter is noticeable by the time and temperature required to temper the butter for judging. This defect is not so very serious but it does interfere somewhat with the spreadability of the product. A de-

duction of one-half point is made for a slightly and one point for a definitely gummy body.

3. Leaky. Butter that shows beads or droplets of moisture on the plug and on the back of the trier is criticized as leaky. The butter fails to retain its moisture due to the large size of the droplets. Leakiness is caused by insufficient working. The butter has not been worked to the point where the water droplets are reduced sufficiently in size to be well distributed throughout the mass of the butter. Replacement of the plug in leaky butter is sometimes accompanied by a slushing sound. Leaky butter is discriminated against because of the economic loss involved in handling and printing. The leaky defect is still more serious if the beads or droplets of moisture appear milky or cloudy. This indicates insufficient washing as well as insufficient working of the butter. Too high a churning temperature resulting in soft granules and the retention of an excessive amount of buttermilk within the granules is also conducive to a milky or cloudy brine in the resulting butter. Milky or cloudy brine not only involves economic loss in handling and printing, but is detrimental to the keeping quality of the butter as well. The flavor is also jeopardized due to lack of blending of the fat, water, salt and curd which make up the butter. A slightly leaky texture merits a deduction of one-half point and a definitely leaky texture one point.

4. Mealy or grainy. A mealy or grainy texture is easily recognized when the sample of partly melted butter is compressed between the tongue and palate. Its physical condition is "grainy" like that of cornmeal mush. The bore is generally cleaner than in the case of crumbly butter. This is a serious texture defect because the butter lacks the smooth waxy texture for which good butter is noted and it shows carelessness on the part of the buttermaker. Mealy texture may be caused by improperly standardizing high acid cream with lime or allowing the butterfat to "oil-off" at some stage of the buttermaking process. Improper melting of frozen cream or allowing some of the fat in the cream to "oil-off" in the pasteurizer or remelting the butter scraps in the pasteurizer may result in butter with a grainy texture. Any one of the foregoing can be controlled by the buttermaker. A very slight mealy texture caused by standardizing high acid cream with lime is not considered very

serious. If the defect is caused from frozen cream or remelting cutting scraps in the pasteurizer, it is then considered one of the most serious texture defects found in butter. For a slightly mealy texture, one point is deducted and for a definitely grainy texture a deduction of two points is made.

5. *Ragged boring.* A full trier of butter cannot be drawn from butter having a sticky-crumbly texture. Not only is it next to impossible to draw a full plug of such butter, but it is also difficult to replace the ill-shaped plug in the trier hole from where it was taken. The butter rolls from the trier rather than the trier cutting a clean plug. Butter exhibiting this sampling difficulty is referred to as "ragged boring" (Figure 35). This

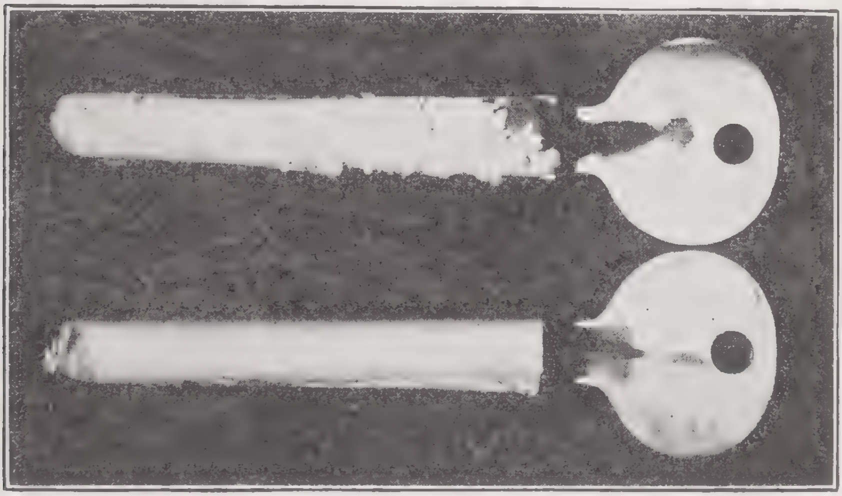


Figure 35 — Waxy and Ragged-Boring Butter.

is a serious body defect, as it not only interferes with the cutting of the butter into serving squares, but interferes with the spreadability as well. The rate of cooling of the cream after pasteurization, the temperature at which the cream is held before churning, the temperature of churning, the temperature of the wash water, or any condition that interferes with a well-made, close-knit texture in butter has a bearing on this defect. A deduction of one point is made for slightly ragged boring butter, and two points if the defect is definite.

6. *Spongy or weak.* A spongy or weak body is shown by the quick melting down or comparative softness of the butter when exposed to ordinary room temperatures. This is not a serious defect, but one which is not in favor with the markets. A weak

bodied butter often yields an imperfect plug, the tendency being for the trier to "cut in" on the plug. When the ball of the thumb is pressed against the plug, difficulty is often encountered in securing a break. Weak body is supposedly due to a state of incomplete fat crystallization which results in an excess of liquid fat in the butter. Incomplete fat crystallization may be due to faulty cooling of the cream after pasteurization or a high proportion of low melting point glycerides in the butterfat. Due to natural variations in the consistency of butterfat in the different butter producing sections, some leeway is made for butter with different body consistencies. Consequently, spongy or weak body in butter is not one of the more serious defects. For slightly spongy or weak body one-half point is deducted. If the defect is definite a whole point is deducted.

7. *Sticky.* As the term implies, a sticky bodied butter sticks to the trier, and has the appearance of being dry (Figure 36).

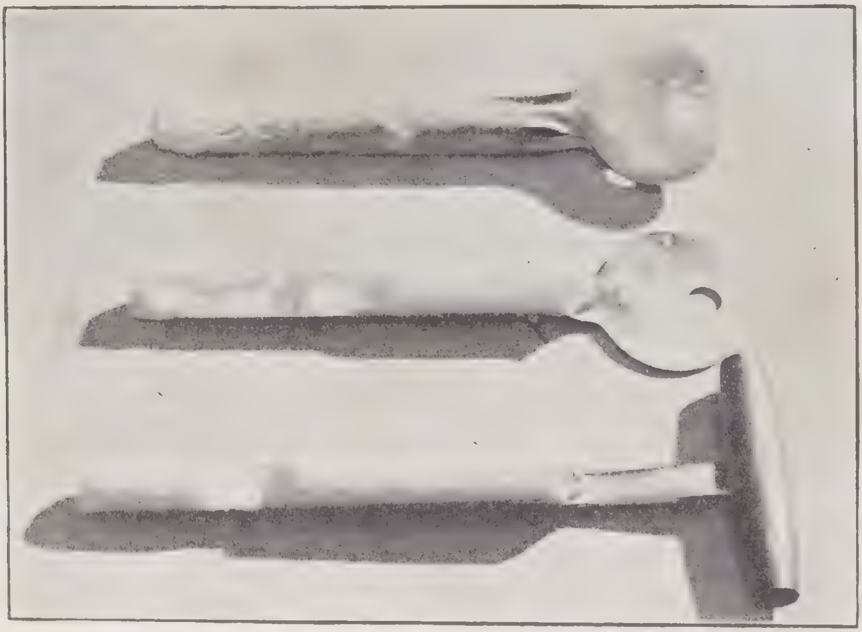


Figure 36 — Upper — Sticky Body Butter; Middle and Lower — Waxy Texture Butter.

Usually it is difficult to secure a clean, even-surface plug. It yields a rather ragged one instead. This is particularly true when the trier is cold. Since the market demands butter that slices and spreads well, this condition is undesirable. As previously stated, when crumbly or brittle textured butter is overworked the entire mass becomes sticky. In fact, sticky body and crumbly

texture can be present in the same sample of butter. Sticky body, like crumbly or brittle texture, is observed most frequently in late fall and winter butter. It is primarily a feed defect and appears to be more prevalent in dairy sections where alfalfa is the main roughage fed to the cows. The temperature treatment of the cream and butter markedly affects the stickiness of butter also. Slightly sticky body merits a deduction of one-half point. A whole point is deducted for a definitely sticky body.

Correlation of body and texture defects. The beginner should understand that two samples of butter may have different body and texture characteristics due to sectional differences and still each sample be given a perfect score of 25 points. Body and texture of butter from different butter producing sections made in the same season of the year will not be exactly the same. Tolerances are allowed for these different characteristics. If a defect is present it should be sufficiently serious as to be observed beyond a doubt. It is also not unusual to have two body and/or texture defects occur in the same sample. Butter with a leaky texture may also have a mealy texture. Sticky-bodied butter may also have a crumbly texture. Due to these dual defects two criticisms are sometimes made. However, in such cases both of the defects must be sufficiently serious so as to be demonstrated beyond a doubt. For the beginner it is generally safer to criticize the more prominent defect and leave the double criticisms to the more experienced judge.

Figure 37 — A Group of College Students Judging Butter in the Collegiate Students' International Contest in the Judging of Dairy Products. (Courtesy Dairy Industries Supply Association.)

Distribution of body and texture defects of butter. In 1941, the Committee on the Judging of Dairy Products of the American Dairy Science Association[8] made a study of the official body and texture defects of the butter used in the Collegiate Students' International Contest in the Judging of Dairy Products from 1926 to 1939, inclusive (Figure 37). This butter was scored by recognized butter judges. The committee pointed out that probably in some cases specific samples exhibiting certain body and texture defects were selected for use in the contest and therefore the percentage distributions reported might not apply to commercial products as a whole. The committee found that of the 104 tubs of butter scored, only 15, or 14.4 percent, were criticized on body and texture. The distribution of the body and texture defects noted in these few samples of butter are presented graphically in Figure 38.

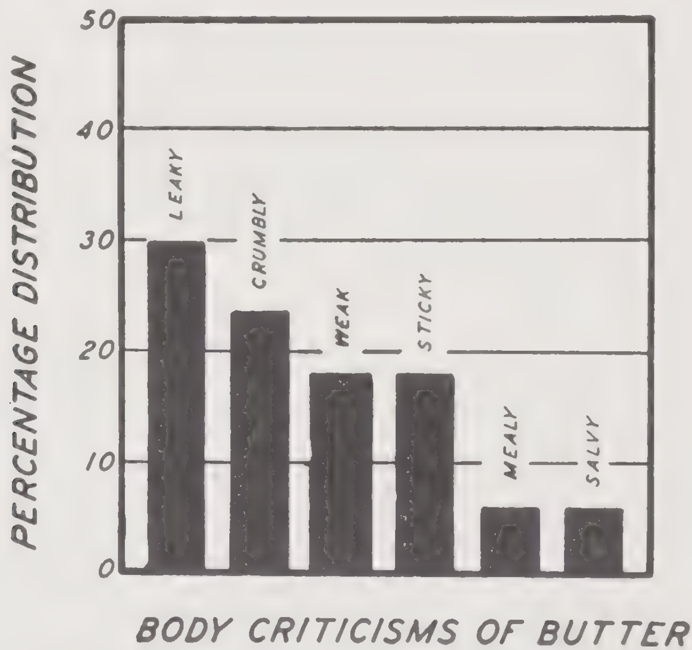


Figure 38 — Distribution of Official Body Criticisms of Samples of Butter Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1926 to 1939, Inclusive.

These data show that 29.4 percent of the body and texture criticisms were "leaky"; 23.5 percent "crumbly"; 17.6 percent each were "weak" and "sticky"; and 5.9 percent each were "mealy" and "salvy." Leaky and weak-bodied butter was noted throughout the period of this judging, whereas, crumbly and sticky butter was encountered particularly within recent years.

The defects seemed to be definitely obvious before the deduction in score for body and texture was made and then the deduction was only one-half point. Emphasis should be placed on the fact that over 85 percent of the samples of butter were scored perfect on body and texture.

Scoring Flavor

Flavor — 45 points

The ability to detect flavors and evaluate them is the most difficult part of butter judging. With very few exceptions, almost anyone with some experience can detect and evaluate the defects previously mentioned under package, salt, color, body and texture. In examining butter for these items the senses of sight and touch are chiefly used.

The items of package, salt, color, body and texture make up 55 points on the butter score card. To become a good judge of butter, the student must become proficient not only in scoring these items but also must learn to score flavor as well. The senses of taste and smell are used in the scoring of flavor. These senses can be developed just as well as those of sight and touch. Practice is of prime importance. Bearing in mind the observations previously noted in the study of the above items, proceed in the scoring of flavor. Recall the aroma which was mentally recorded at the time the trierful of butter was taken and be ready to correlate, if possible, this aroma with the taste sensation about to be observed. Remove about one inch of the end section of the butter plug with a knife or spatula, which, if taken properly, represents the center of the sample, and place this in the mouth. Chew it enthusiastically, thereby bringing the butter into a liquid state as soon as possible. Continue manipulating the sample with the tongue and jaws until the butter becomes of body temperature. Meanwhile, pay little attention to the world about you but practice introspection; that is, look back into your own mind and concentrate upon your task of tasting. Notice the first taste or smell to make its appearance. Observe whether it disappears. Record mentally as you proceed whether there is a succession of flavors; that is, do the first flavors pass off and others appear? Throw back the head and, with the use of the tongue, draw the warm, melted butter to the back of the

mouth. As this is being done, watch for the appearance of the palate flavor. Bear in mind that the sense organs of taste and smell are very delicate and with some flavor sensations the sensitiveness of these delicate organs is easily dulled so that the flavors are no longer observed to be present. In view of this, it is very essential that the beginner pay particular attention to the work of flavor scoring, concentrating his efforts, which in turn will enable him to detect taste reaction of the most delicate flavors.

After getting the palate flavor, expectorate the sample into a container provided for that purpose. This completes the work with the sample. However, the aftertaste must be noted. Observe the taste which remains in the mouth, and note its persistence. Having done this, replace the remainder of the plug in the same hole from which it came to the depth that the end of the plug is level with the surface of the butter in the container. Smooth the trier hole with a knife or spatula which will keep the surface of the butter neat in appearance.

The findings of all the items should now be recorded on the score card, giving each a numerical value, then add these numerical values. The sum represents the score of the sample of butter inspected. This, in general, is the order of procedure followed by the butter judge. His wide experience has revealed some short cuts in the routine of the scoring which enable him to score faster. By following the above procedure, step by step, correct scoring habits are formed, which lead to more proficient work.

The desired flavor of butter is mild, sweet, clean and pleasant. A characteristic of such butter is that the appetite always craves for more. Butter scoring 38 points or higher in flavor is considered to be in a class which is beyond flavor criticism.

A GENERAL GUIDE FOR SCORING THE FLAVOR OF BUTTER

For the beginner the following general guide for scoring the flavor of butter may be helpful:

SCORING GUIDE

Flavor	Flavor score	Total score
PERFECT (Theoretical, never given)	45	100
VERY PLEASING	38-39	93-94*
Fine, sweet, clean, pleasant, aromatic (Only complimentary criticisms given)		
PLEASING	37	92
Slightly: storage, feed, heated cream, flat, coarse		
Definitely: cooked		
FAIRLY PLEASING	36	91
Slightly: acidy, utensil, scorched acid, neutralizer, aged, greasy, woody, bitter, old cream		
Definitely: storage, feed, heated cream, flat, coarse, smothered		
SLIGHTLY PLEASING	35	90
Slightly: weedy, musty, vegetable		
Definitely: acidy, utensil, scorched acid, neutralizer, aged, greasy, woody, bitter, old cream		
SLIGHTLY OBJECTIONABLE	34	89
Slightly: fruity, yeasty, cheesy, oily, metallic, barny, obnoxious weed		
Definitely: sour, scorched old cream, scorched neutralizer, alkaline, vegetable, weedy, musty, stale cream		
OBJECTIONABLE	33	88
Definitely: fruity, yeasty, cheesy, oily, metallic, barny		
Pronouncedly: alkaline, vegetable, musty, stale cream		
VERY OBJECTIONABLE	32	87
Slightly: fishy, onion, garlic		
Definitely: barny		
Pronouncedly: yeasty, cheesy		
Very Pronouncedly: stale cream		
PRONOUNCEDLY OBJECTIONABLE	31	86
Definitely: fishy, onion, garlic		
Pronouncedly: obnoxious weeds		
VERY PRONOUNCEDLY OBJECTIONABLE	30	85
Pronouncedly: onion, garlic		
Very pronouncedly: obnoxious weeds		
NO GRADE	Below 30	0
Pronouncedly: fishy, surface taint, limburger, tallowy, rancid, paint or varnish, chemical, gasoline, kerosene, and fly spray.		

The beginner will recognize early in his judging experience that several of the flavors presented in the above chart may occur in combination rather than singly and, also, that they differ greatly in intensity. He, therefore, should use the chart not to give him a fixed value for the flavor noted in every case, but as a guide by which he may arrive at a definite flavor evaluation for himself. The flavor evaluations for various intensities of off-flavors in butter are in very close agreement as

*Approximate butter score when other items on the score card rate a perfect score.

presented by the Agricultural Marketing Service, United States Department of Agriculture,[10, 11] by the Committee on Score Cards, American Dairy Science Association,[1] and by the Committee on Judging Dairy Products, American Dairy Science Association.[7] Certain variations in flavor evaluation, however do occur. For example, the federal graders are somewhat more tolerant of slightly cooked and normal feed flavors than are the Committees of the American Dairy Science Association. The three aformentioned sources of information were consulted in preparing the flavor scoring guide.

Distribution of flavor criticisms: The Committee on the Judging of Dairy Products[7] of the American Dairy Science Association made a study of the official flavor criticisms of the butter used in the Collegiate Students' International Contest in the Judging of Dairy Products from 1927 to 1938, inclusive. This butter was scored by recognized butter judges. The committee pointed out that probably in some cases samples exhibiting certain specific flavors were selected for use in the contest and therefore the percentage distribution reported might not apply to commercial products as a whole. They found that of the 84 tubs of butter scored, 67, or 79.6 percent, were criticized on flavor. The distribution of the flavor criticisms noted in these few samples of butter are presented graphically in Figure 39. The committee

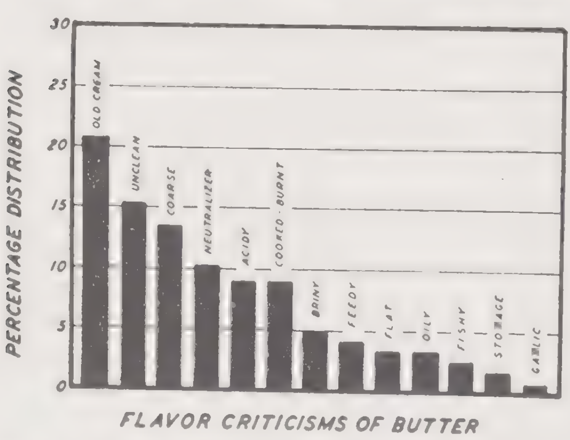


Figure 39 — Distribution of Official Flavor Criticisms of Samples of Butter Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1927 to 1938, Inclusive.

found that 22.4 percent of the flavor criticisms were "old cream"; 15.2 percent "unclean"; 13.6 percent "coarse"; 11.2 percent "neutralizer"; 8.8 percent "acidy"; and 8.8 percent "burnt," "cooked" or "heated." These six flavors accounted for 80.0 percent of all the flavor criticisms. The remaining 20 percent

were divided among "briny," "feed," "flat," "oily," "fishy," "storage," and "garlic" criticisms, with 4.8, 4.0, 3.2, 3.2, 2.4, 1.6 and 0.8 percent, respectively. In the above classification, some associated flavor criticisms were grouped. For example, "stale" and "cheesy" were grouped with "old cream," "bitter" with "neutralizer," "burnt" with "cooked," and so on.

The committee pointed out that inasmuch as an average of 1.87 criticisms per sample criticized was noted, several combinations of flavor criticisms were made. Obviously, if but one criticism were used in the better grade of butter, then at least three criticisms must have been used in the poorer grades in order to maintain such an average. Combinations frequently noted were "coarse, acidy"; "old cream, unclean"; "neutralizer, old cream"; and "neutralizer, old cream, and unclean."

Flavor Defects and Their Characteristics

A knowledge of flavors which may be present in butter and some of the characteristics of those flavors will enable the beginner in scoring butter to express himself with more confidence and, therefore, make it somewhat easier for him to distinguish and identify the flavors observed.

Good butter should have *a clean, sweet, pleasant taste and a delicate aroma.* Aside from its sweetness, pleasantness, and delicateness, butter should have neither a pronounced taste nor smell. If pronounced flavors are noted then some one, or a combination, of flavor defects may be present. In the case of a combination of flavor defects, the most outstanding one should bear the criticism. If two or more flavor defects are present, each one equally prominent, then more than one flavor criticism may be given. The evaluation of the various flavor defects sometimes noted in butter may be found in Table 11.

Acidy. An acidy, or high-acid flavor is common in butter made from high-acid cream, overripe cream, the use of overripe culture, or to the actual presence of buttermilk. If buttermilk is present, as indicated by a milky brine, it is sometimes designated as a buttermilk flavor. Acidy flavor in butter is characterized by the sharp, sour taste on the tongue and its large volume of aroma. The sourness is easily and quickly detected when the butter is placed in the mouth. However, the flavor clears up after a while, leaving the mouth clean. Butter that is

slightly acidy is given a flavor score of 36 points. If it is definitely acidy the flavor score is reduced to 35 points.

Aged. The aged flavor can best be described by the term "lacking freshness." The lack of freshness can be detected both by taste and by smell. Aged flavor should not be confused with storage flavor, which is somewhat similar but which is the result of other causes. Aged flavor is usually caused by the holding of butter for extended periods of time at relatively low temperatures or for short periods of time at relatively high temperatures. If butter, especially print butter, is to be held for extended periods it should be held at 0° F. (−17.7° C.) or lower to guard against the development of aged flavor. A slightly aged butter is given a flavor score of 36. If the aged flavor is definite it is limited to 35 points.

Alkaline. If too much neutralizer is added to sour cream to reduce the acidity, the resulting butter may have an over-neutralized or alkaline flavor. The pH of the serum of the butter will be above the neutral point, which is 7.0. The aroma will definitely suggest neutralizer and the taste will generally be "limy" or soda and sometimes bitter. In extreme cases it is not uncommon for the butterfat to suggest a soapy flavor which is due undoubtedly to a slight saponification of some of the butterfat. This is a serious flavor defect and limits the flavor score to 34. If the alkaline flavor is pronounced the flavor score is limited to 33 points.

Barny. The barny flavor, sometimes called "cowy," is more frequently observed in dairy butter made from raw cream, but it is found sometimes in creamery butter made from pasteurized cream. The odor corresponds to the odor of a cow stable. The flavor is apparent when the sample is first taken into the mouth and persists even after the sample is eliminated. A noticeable characteristic of barny flavor is its persistence on the palate, or failure to "clean up."

Barny flavor is commonly attributed to the absorption of cow-stable odors by the milk or to the lack of proper cooling of the cream immediately after separation. However, experimental evidence does not substantiate these beliefs. The condition of the air with respect to ventilation at time of milking would seem to be directly related to barny flavors. Feeding the cows just before milking seems to be conducive to the presence of a feedy

flavor which sometimes might be misconstrued as a barny flavor in the resulting cream. There is also some evidence that barny flavor can be caused by micro-organisms. A slightly barny flavor limits the flavor score to 34, a definitely barny flavor to 33, and if the flavor is pronounced a flavor score of 32 is given.

Bitter. Bitter flavor is more common in milk and cream than in butter. It occurs more frequently in dairy than in creamery butter. Probably the most common cause of bitter flavor is the breaking down of the fats due to the activity of the enzyme lipase, yielding a fatty acid. The resulting flavor is generally called "rancid," which is bitter in character. Bitter flavor may also be due to impurities in the butter salt or to the improper use of some kinds of neutralizer. The presence of this flavor is easily detected by the sense of taste alone by rolling the melted sample to the back and center of the tongue. The flavor is usually pronounced and persists even after the sample has been expelled from the mouth. Butter with a slightly bitter flavor is allowed a flavor score of 36. If the flavor is definite the flavor score is limited to 35 points.

Cheesy. A cheesy flavor in butter resembles that of cheddar cheese. The presence of this flavor is easily detected from the very first, due both to its intensity and to its cheesy characteristics. From the placing of the sample in the mouth, through the manipulation of the sample and its later expectoration to the last taste, this flavor is noticeable. The flavor is persistent and the mouth fails to clean up. If sour cream is held too long at a warm temperature protein-splitting organisms may break down the casein resulting in a cheesy flavor. When this cream is churned, the cheesy flavor may be carried over into the butter. This flavor can be formed in like manner by micro-organisms, under certain conditions, in butter made from good cream. This is especially true of lightly salted and of unsalted butter. A slightly cheesy flavor limits the flavor score to 34, a definitely cheesy flavor to 33, and if the flavor is pronounced the flavor score is limited to 32 points.

Coarse or Coarse-Acid. Butter which lacks the sweet, pleasing, characteristic delicate flavor associated with butterfat is criticized as coarse. The lack of refinement of flavor is noticed when the sample is first placed in the mouth. Coarse-flavor butter does not particularly give rise to a pronounced, undesirable taste

sensation, but a lack of the pleasant sensation characteristic of higher scoring butter.

A coarse-acid flavor is usually the most difficult flavor for the beginner to detect. He usually cannot find anything definitely wrong with the sample and yet he realizes that it lacks the real, delicate, butter flavor. Some beginners are prone to call a high-salt sample coarse when it should be criticized for sharp salt. Coarse-acid flavor is associated with the butter serum and may be present in unsalted butter as well as in salted butter. A coarse-acid flavor may be caused by a slow development of lactic acid in cream that has been held too long at a moderately low temperature. The butterfat in the cream loses its refinement even though the cream is not distinctly sour to the taste. This is no doubt the reason why it is impossible to make a high-scoring contest butter from other than fresh, sweet cream. A coarse-acid flavor is not a very serious defect, but it limits the flavor score to 37 if slight and to 36 if present to a definite degree.

Cooked. The cooked flavor is generally associated with high grade butter. If this flavor is present it will be revealed to the tongue, palate and mouth. The flavor is readily recognized when the sample is taken into the mouth. Unless the flavor is intense, its presence, as noted by the senses of taste and smell, is of short duration. Providing other flavors are not present, butter with this flavor cleans up well and leaves no aftertaste in the mouth.

Cooked flavor, sometimes known as custard flavor, is caused by pasteurizing cream at a high temperature. It is not unusual to have a slightly cooked flavor in freshly churned butter made from pasteurized cream. This flavor is not objectionable as the United States butter grades allow a cooked flavor in a 93-score butter because this flavor usually disappears before the butter reaches the consumer. High-pasteurization temperature enhances the keeping quality of the butter. Butter with a definitely cooked flavor is limited to a 37-flavor score.

Feed. The presence of the different feed flavors can usually be detected in the aroma and verified on the palate when the butter is melted. The mouth cleans up reasonably rapidly when the sample is expectorated. Feed flavors are more common in dairy than in creamery butter and more frequent in raw-cream creamery butter than in pasteurized-cream creamery butter. Pasteurization and aeration of the warm cream, as is usually done

in a creamery, tends to eliminate the feed flavor in the resulting butter.

Most dry feeds, such as hay, many of the concentrates, silage, green alfalfa, and the various grasses produce a "normal" feed flavor in butter. Even when fed in large quantities they have only a very slight objectionable effect on the flavor of the butter. Green alfalfa produces a characteristic, mild, sweet flavor which is common in much of the butter produced in the irrigated valleys of the Rocky Mountain and the Pacific Coast states, where alfalfa is fed extensively to dairy cows. When cows are turned on fresh grass pasture in the spring or early summer the butter produced may have a "grassy" flavor. The "grassy" flavor is not very objectionable. It is considered a normal feed flavor and is allowed in high scoring butter. Some feeds may impart a bitter flavor to the butter.

Proper feeding routine on the farm will do much to eliminate feed flavors. If the cows are not fed later than three hours before milking the feed flavor in the resulting butter will be greatly minimized. If strongly flavored feeds are fed, the period of time between feeding and milking should be increased.

Butter with a slightly normal feed flavor merits a flavor score of 38. A flavor score of 37 is given if the normal feed flavor is present to a definite degree.

Fishy. As the term indicates, fishy butter has the flavor and aroma characteristic of codfish, codliver oil, or fish meal. The fishy flavor is easily detected when present in butter. This is one of the most serious and most pronounced flavor defects in butter; one which is persistent and fails to clean up. The development of fishiness in butter is favored by high acid, high salt, overworking and the presence of metallic salts. It results chiefly from the chemical decomposition of lecithin. Fishiness is primarily a storage defect but it occurs occasionally in fresh or reasonably fresh butter. A flavor score of 32 points is given to butter with a slightly fishy flavor and 31 points if the fishy flavor is definite. If the fishiness is pronounced the butter is classified as "No grade."

Flat. Butter that lacks the characteristic, pleasing butter flavor is criticized as flat. The absence of the typical butter flavor is noted when the butter is first put into the mouth. The lack of flavor character is more impressive as the butter is being

melted. Flat flavor should not be confused with that noted in lightly salted or unsalted butter. Unsalted butter may have several flavors in sufficient volume for detection, but the lack of salt suppresses rather than enhances them; whereas in butter with a flat flavor there is very little flavor present. Flat flavor is generally caused by a low percentage of fats of volatile acids, low diacetyl and other volatile products that go to make up a desirable butter flavor. Dilution of the cream with water or excessive washing of the butter may also cause a flat flavor. Certain feeds are also more conducive than others to the production of butterfat with less characteristic flavor. Butter that is slightly flat merits a 37-flavor score. If it is definitely flat a 36-flavor score is allowed.

Fruity. A fruity flavor is one of the more serious, although rather uncommon defects of butter. It can be detected both by taste and by smell. The aroma resembles the sweet-like aroma of fruit and the taste carries out the same suggestion. The flavor persists after the sample has been expectorated. Fruity flavor may be caused by bacterial fermentation that takes place in old, sour cream. Fruity flavor may also occur in old-cream butter that has been held in cold storage for several months. If the fruity flavor is slight a 34-flavor score is given. If it is definite the flavor score is reduced to 33 points.

Greasy. Greasy flavor is usually associated with the rapid heating of abnormally rich cream, especially when a small volume of cream is pasteurized. Insufficient holding of the cream after pasteurization to effect adequate chilling of the fat globules may also be associated with greasy flavor. Likewise, cream held too long at too high a temperature before pasteurization, or cooled too slowly after pasteurization, may result in greasy-flavored butter. This flavor can be likened to a mild degree of oiliness. A sample of this butter feels greasy on the palate; it may also have a greasy texture criticism. A greasy flavor is allowed 36 points if slight and 35 if it is definite.

Heated Cream. The heated cream flavor is somewhat difficult to describe. The odor resembles that of cream which has been exposed to the hot summer sun. It may be caused by the growth of bacteria in the cream at high temperatures. The flavor has little or no association with pasteurization. The heated cream butter has a slightly musty-like aroma and the flavor is similar

to that of "smothered" when the butter is melted on the palate. Usually the flavor is neither very pronounced nor very persistent, but cleans up fairly well when the butter is expectorated. For a slightly heated cream flavor a 37 score is allowed. If it is definite the flavor score is reduced to 36 points.

Malty. The malty flavor sometimes encountered in butter markedly resembles that of malted milk and to some extent that of grape nuts. Sometimes the off-flavor is very suggestive of black walnuts. The flavor sensation extends over the entire tasting period and persists after the sample has been expectorated. The malty flavor results from the growth of *S. lactis var. maltigenes* and associated organisms in the cream and the transmissal of the flavor to the butter. Butter having a slightly malty flavor is limited to a flavor score of 36; distinctly malty to 35; and a pronouncedly malty flavor to 34.

Metallic. As the name indicates, metallic flavor is suggestive of metal. The flavor conveys a slightly astringent and puckery feeling to the mouth. When one holds an iron nail in the mouth until the saliva has come in contact with it the result is a very good demonstration of the characteristics of metallic flavor. The metallic flavor may be detected as soon as the butter is placed in the mouth; the flavor generally becomes more intense as the sample is melted down on the palate. To some people the flavor seems flat. The flavor persists after the sample has been expectorated; a somewhat bitter taste may appear at the end of the tasting period.

Metallic flavor is caused by holding sour cream in direct contact with metals such as copper or iron until a metallic salt is formed. This metallic salt is carried into the butter causing the metallic flavor. Rusty cream cans or cans from which the tin has been abraded are possibly the cause of considerable metallic-flavored butter. Butter that is slightly metallic is given a 34-flavor score. The flavor score of definitely metallic butter is limited to 33 points.

Musty. Musty flavor resembles the odor of a poorly ventilated cellar. The aroma of the butter also resembles that of musty hay. When musty-flavor butter is first placed in the mouth the flavor seems to lag behind, not being sensed until the sample is well melted. Usually the flavor is most noticeable when the sample has been expectorated. The mouth fails to clean up.

Musty flavor may be caused by storing cream in a damp, musty-smelling cellar or in a musty-smelling, poorly-ventilated room. Poorly-washed cream separators or poorly-washed cream cans held for several days, especially in the summer months, with the lids on may cause a musty flavor in cream stored in them which in turn will result in a musty flavor in the butter. It is thought that this flavor can be caused by the feeding of musty hay, musty silage or musty grain to dairy cows. For a slight musty flavor a 35-flavor score is given. If the off-flavor is definite the flavor score is reduced to 34 and for a pronouncedly musty sample the flavor score is limited to 33 points.

Neutralizer. The presence of a neutralizer flavor can be observed immediately after the sample has been melted in the mouth. However, it is often more readily perceived just after the sample has been expectorated and air is inhaled through the mouth. This flavor does not clean up very well. If the flavor is pronounced, it may suggest a soda or washing-powder flavor. the soda neutralizers may produce a soda-like taste; whereas the lime neutralizers may produce a bitter-like taste which is sometimes referred to as ''limy.'' A strong neutralizer flavor in butter can also be detected by the odor. A neutralizer or alkaline flavor is generally caused by over-neutralization, by improper methods of adding the neutralizer to the cream, by the use of too concentrated a neutralizer solution, or by the use of relatively large quantities of neutralizer necessitated by the high acid in the cream. If a slight neutralizer flavor is detected the flavor score is limited to 36 points. For a definite neutralizer flavor 35 points are allowed.

Obnoxious-weed. If cows consume weeds having a strong odor the butter made from the cream will be tainted. The obnoxious-weed flavor can be detected both by the taste and by the smell of the butter. The flavor usually lingers after the sample has been expectorated. Obnoxious-weed flavor is serious. If only slight, the flavor score is limited to 33 points but it may be scored as low as 30 points according to the intensity.

Oily. An oily flavor is rarely found in butter made from high-quality, sweet, or slightly sour cream. Occasionally, the defect may be present in butter made from definitely sour cream. Its greatest intensity is usually not observed until after the sample is expectorated. An oily film seems to coat entirely the

tongue, palate, sides and roof of the mouth. Inhaling slowly through the mouth immediately after eliminating the sample conveys a machine-oil-like odor. Oily flavor persists on the palate, being very slow to disappear. Oily flavor results from the oxidation of some of the fatty constituents of butter. The presence of exposed copper in the cream-handling equipment in association with certain treatments of the cream before churning seems to favor the development of oily-flavored butter. High-acid butter made from properly processed cream which is relatively free from copper or iron contamination rarely becomes oily. The pasteurization at high temperatures with subsequent exposure to air and light of improperly neutralized cream or metal-contaminated sour cream may cause an oily flavor in the resulting butter. Slow cooling after pasteurization may also enhance this flavor. Butter with a slightly oily flavor is given a flavor score of 34 points. If the flavor is definite the flavor score is reduced to 33.

Old cream. Old cream is one of the most common flavor defects found in butter. When cream is fresh, sweet, clean and without production or handling defects it is at its best for making butter with a fine, appealing, pleasing flavor. As it ages it loses those fine, desirable flavor qualities that should be transmitted to butter. The older it becomes the faster it deteriorates; and when several days old it will exhibit a typical old cream flavor which will be very noticeable in the resulting butter. Old cream flavor may also be caused by exposing cream to improperly washed cans, utensils and processing equipment. Butter from old cream is characterized by its lack of freshness. When first placed into the mouth, this flavor seems to lag behind, not making its appearance until the sample is well melted. Usually the flavor is most noticeable when the sample has been eliminated from the mouth. The flavor lingers and does not clean up readily. Butter with slightly old cream flavor is scored 36, but if the flavor is definite the flavor score is reduced to 35 points.

Onion or garlic. Onion or garlic flavors are very objectionable in butter. They are easily detected by their peculiar flavors suggestive of their names. These flavors are more pronounced when the sample is heated to body temperature. They persist in the mouth for a considerable period after the sample has been expectorated. Onion and garlic are somewhat similar in flavor;

both are equally objectionable in butter. Butter containing either of these flavors is a low grade product and is given a flavor score ranging from 32 down to 30 points, according to the intensity.

Scorched. A scorched flavor is sometimes referred to as an intensified cooked flavor. It may be caused by any condition in vat pasteurization that does not allow sufficient mixing of the cream or by exposed hot coils coming in contact with the cream during the heating process. The flavor is identified by its peculiar, harsh, burnt protein-like taste which varies slightly with the kind of cream involved. When this flavor is present to a slight degree and associated with acid cream the maximum flavor rating is 36. When definite and associated with old cream the flavor is limited to 34 points.

Scorched-neutralizer. Scorched neutralizer is a flavor defect caused by pasteurizing cream that has not been properly standardized for acidity. It has a very characteristic flavor like old nuts which can be detected both by taste and by smell. This characteristic flavor becomes more intense as the sample is melted on the palate; it persists after the sample is eliminated. The flavor score of butter with this flavor defect is limited to 34 points.

Smothered. When warm cream from the separator is held in a tightly sealed can, particularly if it has not been well cleaned, it may acquire a peculiar, slightly musty flavor which is referred to as "smothered." Also, the storing of cream in open cans in a damp cellar may result in this flavor. Smothered flavor has been attributed generally to improper and delayed cooling of cream. Experimental data seems to upset this assumption in that the flavor is not present in all cream that has not been cooled. This flavor is sometimes referred to as "feverish" because it suggests the non-removal of animal heat from the cream. In other words, the odor is not unlike that of warm, freshly drawn milk. It is suggested, also, that smothered flavor may come from an improperly kept churn. All evidence of smothered flavor seems to point to the production and handling of the cream in equipment which may have contributed stale odors sufficient to cause a lack of freshness in the cream. Butter with a smothered flavor is limited to a flavor score of 36 points.

Sour. Sour flavor in butter is easily detected by the sour taste as soon as the sample is put into the mouth. The sourness still remains on the palate for a while after the butter is eliminated. The after taste is similar to that produced after tasting buttermilk, but is not as pronounced. Sour flavor butter may be caused by the development of too much acid in the cream before churning, or by the retention of too much buttermilk in the butter. Sour flavor butter does not keep well and, if salted, may develop a fishy flavor in storage. Butter with a sour flavor is limited to a 34 flavor score.

Stale cream. When cream of poor quality is held too long it often becomes stale. Faulty sanitation in production and in handling will enhance the stale flavor. Butter made from stale cream will have a stale flavor. Stale butter is easily detected both by the taste and by the smell. The flavor, suggestive of protein decomposition, is quite pronounced. It generally commands the field. The flavor is very prominent from the time the sample is placed into the mouth, through its manipulation and expectoration to the very last taste.

Staleness is a common age defect of unsalted butter made from unripened cream which has been held at room temperature. The defect develops more slowly if the butter is held at 40° F. (4.5° C.) and still more slowly at the lower cold-storage temperatures. It is not uncommon for the stale flavor to develop in unsalted butter after it is removed from storage. The stale flavor may develop into a cheesy flavor if the butter is held at room temperature. Butter with a stale flavor is limited to a flavor score of 34 points.

Storage. A storage flavor is somewhat similar to a stale cream flavor, yet there remains a distinct difference. Storage flavor reveals a lack of freshness, whereas the stale flavor is more pronounced and even more persistent. The flavor seems to be retarded and is observed generally during the latter part of the tasting period.

Butter held for a considerable length of time in cold storage may gradually undergo progressive decomposition of some of the protein, resulting in a storage flavor. The delicate flavor characteristics of high quality butter is lost. Butter made from fresh, clean flavor, sweet cream undergoes this chemical change more slowly and shows less change after a definite stor-

age period than butter made from lower quality cream. Thirty-seven points are allowed for a slight storage flavor and 36 for a definitely storage flavor.

Utensil. As the name implies, this defect is characterized by an "off" flavor and aroma, indicating improper sanitary care of the production utensils, cans and equipment with which the cream and the butter came in contact. Sometimes the flavor is referred to as an "unclean" or "dish-rag" flavor. This flavor manifests itself by the unpleasant odor which becomes intensified as the sample is melted. The flavor persists for some time after the sample is expectorated. The odor is similar to that from a poorly washed can that has stood for some time with the lid closed. Slightly utensil flavor is given a flavor score of 36 and a definitely utensil flavor limits the flavor score to 35 points.

Vegetable. The feeding of strong flavored vegetables and other strong flavored feeds may cause the butter to have the same flavor as that of the vegetable or feed consumed by the cows. Improper feeding of cabbage, turnips, potatoes or rape is likely to result in tainted cream, the flavor of which is intensified in the butter. These flavors are so typical of each vegetable that, when encountered, they are very easily recognized both by the taste and by the smell. The flavor scores for the different intensities of vegetable flavors range from 35 down to 33 points.

Weedy. Weedy flavors in butter are the result of weedy flavored cream. The common weedy flavors are usually seasonal. Some are more common in early spring when the cows are turned into weed infested pastures before the grass is sufficiently developed to furnish enough subsistence while some are more prevalent in late summer and in the fall. Weeds cause specific, often slightly bitter flavors in the butter which are easily detected when once encountered. The flavor is more pronounced after the sample is heated to body temperature and usually the flavor typical of the weed remains in the mouth after the sample has been expectorated. Butter with a slightly weedy flavor is given a flavor score of 35; if the flavor is intense the flavor score is limited to 34 points.

Woody. The woody flavor is easily detected both by taste and by smell. The flavor is more pronounced toward the last of the tasting routine. The odor resembles the fragrant, sometimes piney, odor of a new churn. The taste substantiates the

smell. This flavor may vary from the fresh odor of new hardwood to the somewhat musty odor of water-soaked, or partially decayed wood.

Woody flavor may be caused by cream or butter absorbing a woody flavor from a new churn which has not been properly treated. It may also be caused by packing butter in improperly prepared, unparaffined tubs or cubes. Cream held too long in a poorly cleaned churn may also cause a woody flavor in the butter. Butter with a slightly woody flavor is limited to 36 and, if definite, the flavor score is reduced to 35 points.

Yeasty. This flavor is easily detected in the early stages of development by its typical fruity, yeasty, and slightly fragrant aroma, which is apparent when the sample is first taken into the mouth. As the sample is melted the odor becomes more and more distinctly yeasty. This flavor defect of butter occurs mostly during the hot summer months and is due to the by-products formed by yeast growing in the cream. Old, yeasty cream may also impart a bitter flavor to the resulting butter. Yeasty flavor is a somewhat serious defect inasmuch as it indicates that the cream from which the butter was made had undergone considerable decomposition. The flavor score of butter with a slightly yeasty flavor is limited to 34 points; if the flavor defect is definite the flavor is scored 33; and if pronounced the flavor score is limited to 32 points.

Flavor Defects That Cause Butter to be Classified as "No Grade"

There are some flavor defects in butter which are so serious that the butter containing them is not accepted by consumers for table use. Some of these defects are due to micro-organisms breaking down the protein in the curd; some to a chemical breakdown of the fat; some are due to the absorption of strong, penetrating foreign odors, while others may be due to direct contamination. These flavor defects are generally sufficiently prominent that they can be easily detected by smell. The flavor is generally so strong that it persists long after the sample has been eliminated from the mouth.

Chemical. Chemical flavor in butter may be traced to improper chlorination of the churn or the treatment of parchment liners with too strong a chlorine solution. The use of certain strong-scented, iodoform or phenol salves on the teats of the cows may also result in a chemical flavor in the butter.

Gasoline, kerosene or fly spray. These are rather uncommon flavor defects in butter but occasionally one is found. These petroleum products are very detrimental when they come in contact with either the butter or the cream from which it is made. The presence of any one of them is easily detected, especially when the sample is heated. The fumes resulting from burning a petroleum product will also taint butter very readily.

Paint or varnish. Paint or varnish flavors in butter may result from absorption or by contamination with milk or cream. Butter shipped in newly painted, refrigerator cars or butter made while the butter room is being painted may absorb the paint odor.

Rancid. The rancid flavor of butter is strong, soapy and bitter. It somewhat resembles the strong, disagreeable flavor of darkened, decayed nut meats. It is common in raw cream butter, particularly during the winter season when the cows are in late lactation and have been on dry feed for a long time. The odor is pungent and resembles that of butyric acid. When butter is rancid, the flavor defect is obvious and is easy to detect without warming the sample in the mouth. However, warming the sample increases the volume of flavor and thereby furnishes additional evidence that rancidity is present. When this flavor is very prominent it gives the impression of soapiness and at times is pronouncedly bitter. Rancid flavor is the result of the hydrolysis of the butterfat through enzymic action liberating fatty acids and glycerol. The rancid flavor is attributed to the free butyric acid present.

Surface taint or limburger. Surface taint is a very serious flavor defect which is easily recognized by its putrid, decayed and unclean character. As the name suggests, it is generally more pronounced on the surface of the butter. This flavor varies in intensity. Sometimes this flavor is referred to as "limburger" because it resembles the odor of limburger cheese. The flavor is very apparent by the odor and, if intense, it can be detected as soon as the sample gets close to the nose. The taste is apparent immediately after the sample is put into the mouth and resembles that of decayed meat.

This defect, as the name also implies, is caused by protein-digesting bacteria which break down the protein in the curd. The bacteria may gain entrance into the butter by inefficient pasteurization of the cream, by leaks in pipes or linings of vats

by faulty plant sanitation or through the water used to wash the butter. Disposing of butter-cutting scraps by adding them to the freshly churned butter and reworking them into the fresh butter has also been known to result in this defect. The growth of the organisms is enhanced by low acid and low salt in the butter and the presence of air which is indicated by the defect first appearing on the surface of the butter. As would be expected, the defect appears more frequently in unsalted butter than in salted butter. This is especially true if the acid in the unsalted butter is low.

Tallowy. As the name suggests, this flavor resembles the odor and taste of tallow. The flavor varies in intensity. It appears more prominent immediately after the sample has been expectorated. In some cases butter with a tallowy flavor has a bleached color. Tallowy flavor is caused by the oxidation of the unsaturated fatty acids in butterfat. Its development is favored by holding butter at high storage temperatures in the presence of light, and by contamination with certain metallic salts. Copper and iron are the two metals generally involved. Adding so much neutralizer to cream that it becomes alkaline may accelerate oxidation of the fat in the resulting butter to the extent that it becomes tallowy.

Placing an Evaluation on Flavor

With some practice the beginner will soon recognize with assurance many of the flavor defects of butter. He may hesitate, however, in placing an evaluation upon them. A compilation of the evaluations of the various flavor defects of butter, as made by recognized groups of authorities, is included in Table 11.

Table 11 — Comparison of flavor ratings of butter having certain flavor defects, as rated by the Committees on Score Cards and Judging Dairy Products, American Dairy Science Association, and by the Agricultural Marketing Service, United States Department of Agriculture

	Flavor Score or Butter Rated According to			
	(1)*	(9)	(10)	(11)
Acidy				
Slightly acidy	36–36.5	36.4**	91	A
Definitely acidy	35–35.5	35.1	90	B
Definitely sour	34–34.5	34.0	89	C
Aged (butter)				
Slightly	....***	....	91	A
Definitely (distinct)	....	....	90	B
Pronouncedly (strong)	....	....	..	..

Barny				
Slightly	....	....	89	..
Definitely (distinct)	....	....	88–87	C
Pronouncedly (strong)	....	....	..	..
Bitter				
Slightly	35–35.5	35.8	91	A
Definitely (distinct)	34–34.5	34.4	90	B
Pronouncedly (strong)	33–33.5	33.0	..	..
Cheesy				
Slightly	33–33.5	33.8	..	..
Definitely (distinct)	32–32.5	32.6	..	C
Pronouncedly (strong)	30–31.5	31.4	..	CG
Chemical	....	....	NG	NG
Coarse				
Slightly	37–37.5	37.2	92	A
Definitely (distinct)	36–36.5	36.0	91	B
Pronouncedly (strong)	35–35.5	35.1	..	..
Cooked				
Slightly	37–37.5	37.9	93	..
Definitely (distinct)	....	37.0	92	AA, A
Pronouncedly (strong)	35–35.5	35.7	..	..
Cowy				
Slightly	....	35.7	..	..
Definitely (distinct)	34–34.5	34.7	..	..
Pronouncedly (strong)	33–33.5	33.3	..	..
Feed				
Very slight normal	....	....	93	AA
Slightly	37–37.5	37.6	92	..
Definitely (distinct)	36–36.5	36.2	91	A
Pronouncedly (strong)	35–35.5	35.0	..	..
Fishy				
Slightly	32–32.5	32.6	87	..
Definitely (distinct)	30–31.5	31.2	86	CG
Pronouncedly (strong)	....	31.0	NG	NG
Flat				
Slightly	37–37.5	37.8	92	A
Definitely (distinct)	36–36.5	36.9	91	..
Pronouncedly (strong)	....	36.3	..	..
Fruity				
Slightly	....	....	89	..
Definitely (distinct)	....	....	88	C
Pronouncedly (strong)	....	....	..	CG
Gasoline				
Slightly	32–32.5	32.0	NG	NG
Definitely (distinct)	30–31.5	31.3	NG	NG
Pronouncedly (strong)	....	31.5	NG	NG
Greasy				
Slightly	....	....	91	..
Definitely (distinct)	....	....	90	B
Pronouncedly (strong)	....	....	..	..

Heated cream				
Slightly	....	....	92	A
Definitely (distinct)	....	....	91	..
Pronouncedly (strong)	....	....	..	..
Limburger	....	....	NG	NG
Malty				
Slightly	36–36.5	36.2	..	..
Definitely (distinct)	35–35.5	35.0	..	..
Pronouncedly (strong)	33–33.5	33.8	..	..
Metallic				
Slightly	34–34.5	34.4	89	..
Definitely (distinct)	33–33.5	33.2	88	C
Pronouncedly (strong)	30–31.5	31.5	..	..
Musty				
Slightly	35–35.5	35.2	90	B
Definitely (distinct)	34–34.5	34.0	89	C
Pronouncedly (strong)	32–32.5	32.4	88	..
Neutralizer				
Slightly	35–35.5	35.9	91	..
Definitely (distinct)	34–34.5	34.5	90	B
Definitely (scorched-neutralizer, strong)	33–33.5	33.3	89	C
Definitely alkaline	....	....	89	C
Pronouncedly alkaline	....	....	88	CG
Oily				
Slightly	34–34.5	34.6	89	..
Definitely (distinct)	33–33.5	33.3	88	C
Pronouncedly (strong)	32–32.5	32.2	..	..
Old cream				
Slightly	35–35.5	35.8	91	..
Definitely (distinct)	34–34.5	34.1	90	B
Pronouncedly (strong)	33–33.5	33.6	..	..
Onion or garlic				
Slightly	32–32.5	32.6	87	C
Definitely (distinct)	30–31.5	31.2	86	CG
Pronouncedly (strong)	....	30.5	85	..
Paint or varnish	....	....	NG	NG
Rancid				
Slightly	33–33.5	33.0	NG	NG
Definitely (distinct)	32–32.5	32.7	NG	NG
Pronouncedly (strong)	30–31.5	31.2	NG	NG
Scorched				
Slightly	....	....	91	..
Definitely (distinct)	....	....	90	B
Pronouncedly (strong)	....	....	89	..
Smothered				
Slightly	....	....	..	A
Definitely (distinct)	....	....	91	..
Pronouncedly (strong)	....	....	..	..

Sour				
Slightly	....	....	..	..
Definitely (distinct)	....	....	..	C
Pronouncedly (strong)	....	....	..	..
Stale cream				
Slightly	....	....	..	..
Definitely (distinct)	....	....	89	C
Pronouncedly (strong)	....	....	88	CG
Very pronouncedly	....	....	87	..
Storage				
Slightly	37–37.5	37.1	92	A
Definitely (distinct)	35–35.5	35.8	91	B
Pronouncedly (strong)	35–35.5	35.0	..	..
Surface taint	....	....	NG	NG
Tallowy				
Slightly	34–34.5	34.0	NG	NG
Definitely (distinct)	32–32.5	32.7	NG	NG
Pronouncedly (strong)	....	32.7	NG	NG
Unclean				
Slightly	35–35.5	35.8	..	..
Definitely (distinct)	34–34.5	34.3	..	..
Pronouncedly (strong)	33–33.5	33.0	..	..
Utensil				
Slightly	....	....	91	..
Definitely (distinct)	....	....	90	B
Pronouncedly (strong)	....	....	..	..
Vegetable (cabbage, rape, turnip, potato)				
Slightly	....	....	90	B
Definitely (distinct)	....	....	89–88	C
Pronouncedly (strong)	....	....	..	..
Weedy				
Obnoxious weeds:				
Slightly	....	....	88	C
Definitely (distinct)	....	....	87	CG
Pronouncedly (strong)	....	....	86–85	..
Ordinary common weeds:				
Slightly	35–35.5	35.8	90	B
Definitely (distinct)	34–34.5	34.3	89	C
Pronouncedly (strong)	32–32.5	33.0	..	..
Woody				
Slightly	36–36.5	36.2	91	B
Definitely (distinct)	35–35.5	35.1	90	..
Pronouncedly (strong)	34–34.5	34.2	..	..
Yeasty				
Slightly	34–34.5	34.0	89	..
Definitely (distinct)	33–33.5	33.0	88	C
Pronouncedly (strong)	32–32.5	32.3	87	CG

Key * (1), (9), (10) and (11). Citations to be found under "References" at end of chapter.

**The score represents the average of scores given, in most cases, by five selected butter judges, working independently, hence the odd decimal.

***Indicates that no evaluation was made.

Reference to this table will be very helpful to the beginner. The remarkable similarity of the evaluations for specific flavor defects speaks well for the reliability of butter judging. The normal range of score on flavor of butter is from 31 to 39.

Placing a Score or Grade on the Butter Examined

In general there are two prevailing methods of placing a score or grade on the butter examined. These are briefly as follows:

1. Addition of the numercial values allotted flavor, body, color, salt and package. This method is recognized as the *score-card system.*

2. Deduction from the total butter score, which is based upon flavor, the excess demerits, or deductions, on body, color, and salt which are permitted in butter of that rating. This system is known as the *federal grading system.*

A comparison of the two grading systems is given in Table 12. The score-card system makes use of the score card, each item of which has an assigned rating. The federal grading system disregards the score card, but considers similar items, except package, on the basis of possible demerits, or deductions, which are tolerated in each grade of butter. The score-card system has a comparatively fixed scale of demerits for body and texture, for color and for salt, regardless of the flavor score. The federal grading system tolerates more intense defects in body, in color, and in salt in the lower flavor rating butter.

Regardless of the method of arriving at the final and hence the grade to which the butter belongs, the exponents of the two systems of scoring or grading must go through the same procedure of examining, tasting and smelling of the butter as previously described. Furthermore both systems are in general agreement as to the numerical score for flavor, providing the sample is perfect in other respects.

Determining the score by the score-card system. The numerical score of butter is determined after the condition of the package has been observed, the color, salt, and body and texture examined and the flavor determined. Deductions for defects found in any of the items are made according to intensity as described under the description of each defect in this chapter. The sum of all the items after the deductions for defects are made is the numerical score or grade of the sample.

Table 12 — A Comparison of the Score Card System and the Federal Grading System for Determining Butter Grades

Sample number	Grading butter by the score-card system						Grading the same butter by the federal grading system							
	Score allowed for							Basis of deduction from original flavor rating						
	Flavor	Body	Color	Salt	Package	Final score or grade	Flavor rating allowed	Value of defects in Body	Value of defects in Color	Value of defects in Salt	Total value of defects	Total defects per-mitted in this flavor rating	Defects in excess of those per-mitted	Final score or grade
1	38	24½	15	10	5	92½	93—AA	½	0	0	½	½	0	93 or AA
2	38	24½	15	9½	5	92	93—AA	½	½	0	1	½	½	92[1] or A
3	34	24	15	9	5	87	89— C	1	0	1	2	1	1	88 or CG
4	35	24½	14½	10	5	89	90— B	½	½	0	1	1	0	90 or B
5	37	24	14	10	5	90	92— A	1	1	0	2	½	1½	90[1] or B

[1]In the federal grading system fractions are eliminated and the grade expressed in the next lower whole number.

Table 13 — The U. S. Grades of Creamery Butter and the Flavor Defect Intensity Permitted in Each Grade

Flavor defects	U. S. grade AA or 93 Score (Fine, highly pleasing)	U. S. grade A or 92 Score (Pleasing, desirable)	U. S. grade B or 90 Score (Fairly pleasing)	U. S. grade C or 89 Score (Possessing definite flavor defects)	U. S. C. G. or Cooking grade (Possessing definite objectionable flavor defects)
	Flavor defect intensities permitted in each grade				
Feed (normal)	slight	definite			
Cooked	definite	definite			
Coarse-acid cream		slight	definite		
Smothered		slight			
Heated cream		slight			
Aged (butter)		slight	definite		
Storage		slight	definite		
Bitter		slight	definite		
Flat		slight			
Weedy (common)			slight	definite	
Musty			slight	definite	
Cabbage			slight	definite	
Rape			slight	definite	
Turnip			slight	definite	
Woody			slight		
Old cream			definite		
Acidy			definite		
Utensil			definite		
Scorched			definite		
Neutralizer			definite		
Greasy			definite		
Obnoxious weed				slight	definite
Onion or Garlic				slight	definite
Scorched-neutralizer				definite	
Sour				definite	
Fruity				definite	pronounced
Yeasty				definite	pronounced
Cheesy				definite	pronounced
Alkaline				definite	pronounced
Oily				definite	
Metallic				definite	
Stale				definite	pronounced
Barny				definite	
Fishy					definite

Determining the grade by the Federal grading system. The federal score or grade of butter is derived from the flavor rating. The flavor rating is determined by the seriousness and intensity of the most pronounced defect found in the sample. The defects and the intensities permitted in each score or grade are given in Table 13. The final score or grade of the sample is then determined by deducting from the flavor rating the amount that the total ratings of the defects in body, color, and salt (Table 14) is in excess of the ratings for defects permitted in these factors for butter of that particular flavor rating (Table 15). The official United States score is always expressed as a whole number by lowering any half score to the next lower full score.

Table 14 — Values for Different Intensities of Defects in Body, Color, and Salt of Butter According to the Federal Grading System

Defects	Intensity of defects which are valued at		
	½ point	1 point	2 points
BODY			
Crumbly	slight	definite	
Gummy	slight	definite	
Leaky	slight	definite	
Mealy	very slight	slight	definite
Ragged boring		slight	definite
Spongy or weak	slight	definite	
Sticky	slight	definite	
COLOR			
Color specks	slight	definite	
High (unnatural)		pronounced	
Mottles		slight	definite
Streaks		slight	definite
Wavy	slight	definite	
SALT			
Gritty		slight	definite
Sharp	slight	definite	

GRADING BUTTER

The butter judge is frequently called upon to grade shipments of butter on wholesale terminal markets, butter sold on a contract sale or butter to be cut, packaged and sold to the consumer under a definite quality label. With the exception of a few

states that have established state consumer quality standards, butter is generally graded under the U. S. grade standards given in Table 15. Complete Official United States Standards for grades

Table 15 — Limits of Body, Color and Salt Defects Tolerated In the Various U. S. Grades of Butter

U. S. Grade or Score	Possible combinations of flavor ratings and total deductions for defects in body, color and salt which permit butter to receive the full designated U. S. grade.	
	Flavor Rating	Limits of defects tolerated in body, color and salt
93 or AA	93 or AA	0 to ½
92 or A	93 or AA	1 to 1½
	92 or A	0 to ½
90 or B	93 or AA	2 to 2½
	92 or A	1 to 1½
	90 or B	0 to ½
89 or C	92 or A	2 to 2½
	90 or B	1 to 1½
	89 or C	0 to 1½
CG	90 or B	2 or more
	89 or C	2 or more

of creamery butter will be found in the Appendix. In examining butter the judge generally follows a definite routine, carefully observing, inspecting and evaluating the factors that determine the grade.

Identification of churning: Before beginning to grade, the judge should insist that each churning be properly identified. The name of the plant, churning number, number of packages in the churning, the net weight and date churned should be plainly stamped on each package.

Name of Plant ....

Address ....

Churning No. ....No. of Pkgs. ....

Net Weight ....Date Churned.................

Figure 10 — Identification Which Should Be Stamped on Each Butter Package

All packages should be marked at the plant, after each churning is packed. A convenient method of marking is to stamp each package with a special stencil stamp as shown in Figure 40. Then fill in the churning number, the number of packages in the churning and the net weight with a number stamp, and the date churned with a date stamp.

Selection of the samples: A sample package is selected from each churning in the shipment and stamped "Sample," for future identification. Whenever possible, the judge should select the sample from each churning and at the same time casually observe the general condition of the exterior of the other packages in the churning to see if they are in good condition.

Inspection of each sample: The top of the container should be carefully removed and the conditions and arrangement of the parchment liner carefully observed. The butter should be removed from the package by inverting the opened container on the platform of an accurate scale to determine the net weight. If the butter is packed in a paper or a wooden tub, it will usually come out of the container without difficulty. If the butter is packed in a paper or a wooden cube it will be necessary to spread the sides of the container to remove the butter. This can be accomplished by cutting one corner of the paper cube from top to bottom or if the butter is in a wooden cube by pulling all the nails on one corner and spreading the adjacent sides. After removing the butter inspect the container carefully.

To meet standard package specifications the inside of all wooden containers, including the lid, should be coated with an even, close-adhering coating of paraffin. The inside surface finish of a paper container is generally such that paraffining is unnecessary. Regardless of the kind of a container, the package must be lined with a smooth, unbroken parchment liner, neatly folded at the top to give the butter complete protection from the inside surfaces of the package. If the butter is sold on a contract that calls for definite container specifications, such as soundness and dimensions of the wood, nailing and wire strapping, all the containers should be inspected to see that they meet the requirements.

While the butter is still on the scale, it should be checked for net weight. The weight of the parchment-covered butter, less the weight of the parchment, should be equal to the net weight

D. A. 47
(Rev. 1-1-40)

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

OFFICIAL BUTTER GRADER'S MEMORANDUM

☒ Original. ☐ Regrading. ☐ Nonappeal. ☐ Appeal.

Application—Date March 2, 1945 Hour 8:00 A.M.

Certificate No. 517211 Date March 2, 1945 Hour 10:30 A.M.

Applicant Eatmore Butter Company

Address Cowslip Montana

Shipper or seller* Eatmore Butter Company

Address Cowslip Montana

Receiver or buyer* To be Sold

Address

Name of manufacturer Eatmore Butter Co

Address Cowslip Montana

Car initials and number SF 20630 Kind of car Refrigerator

Condition of car Good – Iced

Where graded Cowslip Montana

Total packages 350 Marked net weight 63#

Number of packages examined 25 Kind of package 63# Fiber box

Stencil or marks Lot Numbers & Churning Numbers

Grading fee based on Churnings and expense

This lot of butter graded U. S. AA – A – B – C

Packages { were / ~~were not~~ } stamped with { Score and date. / ~~U. S. V. B. stamp.~~ / ~~U. S. M. C. stamp.~~ }

Fee .... $ 2.40 5.50

Expenses 3.40

Total charge .... $ 11.30

Time required .... 2½ hours.

COPY

Official Grader.

Official Grader.

*As stated by applicant.

10—1407

Figure 41 — Official Butter Grader's Memorandum Which Is Made When Butter Is Graded. (Front.)

stamped on the package. A convenient method of getting the equivalent weight of the parchment liner that surrounds the butter is to weigh a similar liner of equal size, quality and condition and use this as a tare weight. For example, if a similar liner weighs three ounces and the container is marked 63

pounds net weight, then the butter plus the surrounding liner must weigh 63 pounds, 3 ounces, to net 63 pounds of butter.

The next step is to place the butter back into the container and carefully unfold the parchment liner and sample the butter. A trier of butter is taken and carefully inspected for salt, color, body and texture, and flavor qualities as described in this chapter. From these findings the U. S. grade is determined as described in this chapter. Each box is usually stamped with a United States Department of Agriculture number or symbol indicating that the butter was graded by a federal butter grader.

Marking up the scores: After each sample is scored, the results are tabulated on the back of the Official Butter Grader's Memorandum (Figure 42). The churning number and number of packages in the churning are entered in the first two columns. If the date churned is marked on the sample, it is entered in the column marked date of manufacture. If no date is given, then the term "fresh" or "storage" is inserted in this column according to the kind of butter being graded. In the weight column the marked weight is entered. If the samples weigh up to or above the marked net weight, the test weight is marked "O. K." If the weight is short, the actual net weight is marked in the test weight column. The flavor rating is entered in the flavor rating column and the rating and intensity entered in the body, color, and salt columns respectively. The intensity ratings of all defects are then added, and the sum entered in the total defects column. If the total defects are in excess of that allowed in that flavor rating, the excess is entered in the excess defects column. If the total of the excess defects is not greater than that allowed in that flavor rating, the sample is given the same grade as the flavor rating. If the total of the excess defects is greater than that allowed in that flavor rating, the U. S. grade of the butter is lowered accordingly as illustrated in Tables 12 and 15. The defects and their intensities which caused the sample to be placed in the grade are entered under comments.

Preparing the grading certificates: Before the grading certificate can be prepared, the total net weight of the shipment or consignment must be determined. The net weight of each churning is determined by multiplying the number of packages by the marked net weight on the "sample." If the "sample" is short in weight, the net weight of the churning is determined

Churn No.	No. pkgs.	Date mfr.	Weight (Lb.) Mark	Weight (Lb.) Test*	Flavor rating	Rating and Intensity Body	Rating and Intensity Color	Rating and Intensity Salt	Total defects	Excess defects	U. S. score	Comments
			Lot No 240									
151	21		63	63	AA		L	M			93 or AA	Sl. Feed
152	19		63	63¾	A	½	"	"	½	0	92 " A	Sl. C. Acid
153	17		63	63	AA	½	"	"	½	0	93 " AA	Sl. Leaky
154	16		63	62¾	A		"	"			92 " A	Sl. Bitter.
155	18		63	63	AA	1	"	"	1	½	92 " A	Def. Leaky.
156	20		63	63	A		"	"			92 " A	Sl. C. Acid C.
			Lot No 361									
4	15		63	63¼	AA		VL	M			93 or AA	Def. Coarse
5	15		63	63¼	AA		"	"			93 " AA	" "
6	14		63	63¼	AA		"	"			93 " AA	" "
7	16		63	63¼	A		"	"			92 " A	Sl. bitter.
8	14		63	63¼	A		"	"			92 " A	Sl. Smoth.
			Lot No 400									
40	12		63	62¾	B		L	MH			90 or B	Def old Cv.
41	14		63	62½	B	1	M	"	1	½	89 " C	" Def Leaky.
42	8		63	63	C		L	"			89 " C	Def. Stale Cv.
43	12		63	63	C		"	"			89 " C	Def. Alkaline
44	14		63	62½	B		"	"			90 " B	" Neutralizo
45	11		63	63	B	½	M	"	½	0	90 " B	" Metallic
46	10		63	63	B		L	"			90 " B	Sl. Leaky. Def Utensil.
			Lot No 200									
25	12		63	63	A		M	M			92 or A	Sl. C Acid Cv.
26	11		63	63	A		"	"			92 " A	" " " "
27	10		63	63	A	1	"	"	1	½	90 " B	" Def Crumbly
28	14		63	62¾	A	1	"	"	1	½	90 " B	Sl. C. Acid Cv.
29	12		63	62¾	A	2	"	"	2	1½	89 " B	Def. Mealy. Sl. C. Acid Cv.
30	10		63	63	B		L	"			90 - B	Def Mottled. Def C Acid Cv.
31	12		63	63	B		L	"			90 - B	Def Scorched.

COPY

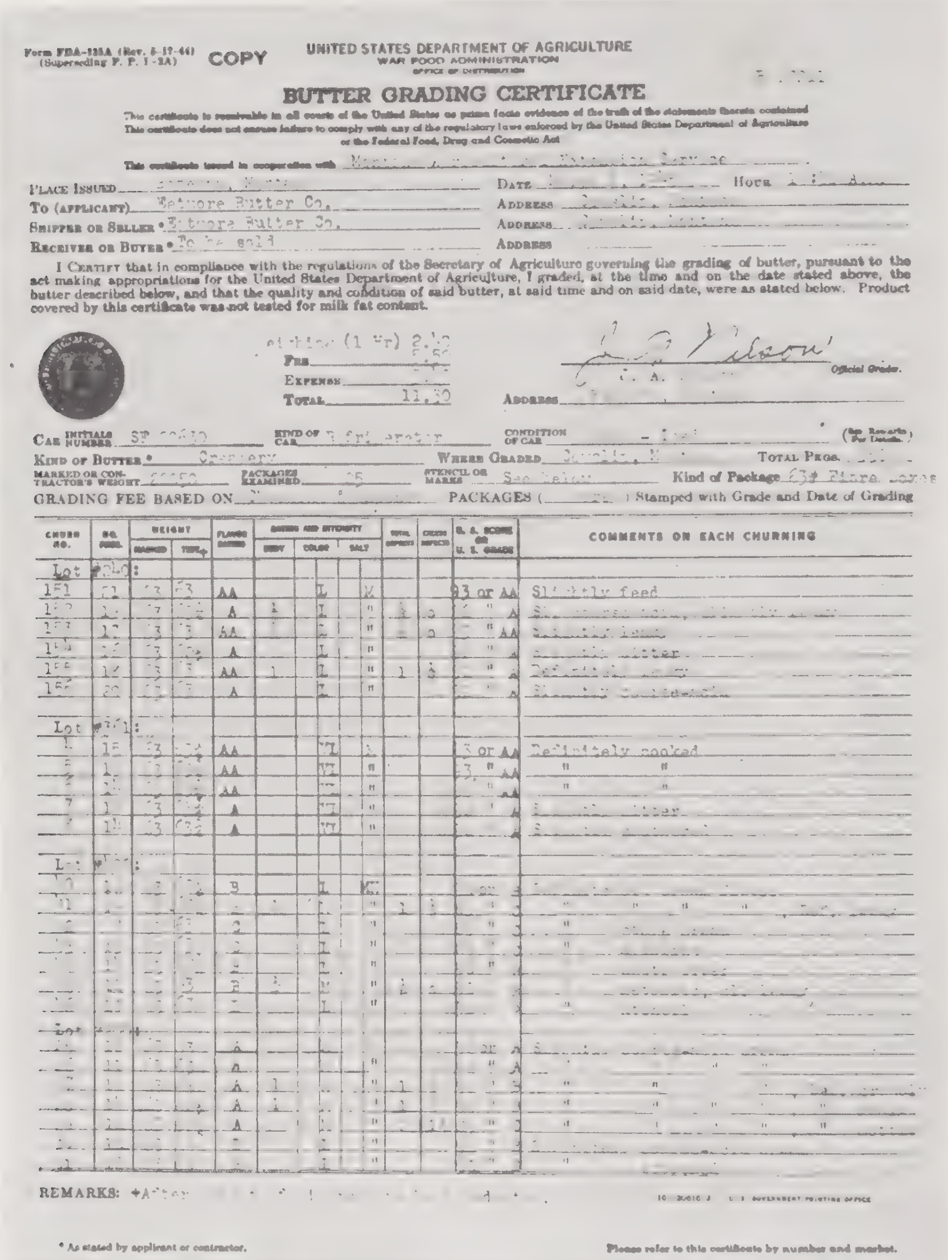
U. S. GOVERNMENT PRINTING OFFICE

REMARKS: (Condition of package, car, etc.)

* Net weight after the weight of the liners have been Deducted.

Figure 42 — Official Butter Grader's Memorandum Which Is Made as Butter Is Being Graded. (Back.)

by multiplying the number of packages in the churning by the actual net weight of the sample. For example, in a churning containing 20 packages, the sample is marked 68 pounds, but the net weight is found to be 67¾ pounds; then the net weight of the churning is 20 x 67¾ or 1355 pounds. The total net weight



Form FDA-135A (Rev. 8-17-44) (Superseding F. P. I-3A) COPY

UNITED STATES DEPARTMENT OF AGRICULTURE
WAR FOOD ADMINISTRATION
OFFICE OF DISTRIBUTION

BUTTER GRADING CERTIFICATE

This certificate is receivable in all courts of the United States as prima facie evidence of the truth of the statements therein contained. This certificate does not excuse failure to comply with any of the regulatory laws enforced by the United States Department of Agriculture or the Federal Food, Drug and Cosmetic Act.

This certificate issued in cooperation with [illegible]

PLACE ISSUED [illegible] DATE [illegible] HOUR [illegible]
TO (APPLICANT) Fetmore Butter Co. ADDRESS [illegible]
SHIPPER OR SELLER * Fetmore Butter Co. ADDRESS [illegible]
RECEIVER OR BUYER * To be sold ADDRESS

I CERTIFY that in compliance with the regulations of the Secretary of Agriculture governing the grading of butter, pursuant to the act making appropriations for the United States Department of Agriculture, I graded, at the time and on the date stated above, the butter described below, and that the quality and condition of said butter, at said time and on said date, were as stated below. Product covered by this certificate was not tested for milk fat content.

Grading (1 hr) [illegible]
FEE [illegible]
EXPENSE
TOTAL 11.30

Official Grader.
ADDRESS

CAR INITIALS NUMBER SF [illegible] KIND OF CAR Refrigerator CONDITION OF CAR [illegible] (See Remarks for Details)
KIND OF BUTTER * Creamery WHERE GRADED [illegible] TOTAL PKGS. [illegible]
MARKED OR CONTRACTOR'S WEIGHT [illegible] PACKAGES EXAMINED 25 STENCIL OR MARKS See below Kind of Package 63# Fibre boxes
GRADING FEE BASED ON [illegible] PACKAGES ([illegible]) Stamped with Grade and Date of Grading

Churn No.	No. Pkgs.	Weight Marked	Weight Tare	Flavor Rating	Body	Color	Salt	Total Defects	Check Defects	U. S. Score or U. S. Grade	Comments on each churning
Lot [illegible]:											
151	[illegible]	[illegible]	[illegible]	AA		L	M			93 or AA	Slightly feed
[illegible]	[illegible]	[illegible]	[illegible]	A	[illegible]	L	"	[illegible]	[illegible]	" A	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	AA		L	"	[illegible]	[illegible]	" AA	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A		L	"			" A	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	AA	1	L	"	1	[illegible]	" A	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A		L	"			" A	[illegible]
Lot [illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	AA		VL	[illegible]			93 or AA	Definitely cooked
[illegible]	[illegible]	[illegible]	[illegible]	AA		VL	"			93 " AA	" "
[illegible]	[illegible]	[illegible]	[illegible]	AA		[illegible]	"			" AA	" "
[illegible]	[illegible]	[illegible]	[illegible]	A		VL	"			" A	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A		VL	"			" A	[illegible]
Lot [illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	B		L	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	"	1	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	"			" [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		L	"			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	"			" [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	B	[illegible]	[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		L	"			[illegible]	[illegible]
Lot [illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	A		[illegible]				[illegible] or A	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A		[illegible]	"			" A	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A	1	[illegible]	"	1		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A	1	[illegible]	"	1		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A		[illegible]	"		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	"			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	"			[illegible]	[illegible]

REMARKS: * [illegible]

* As stated by applicant or contractor.

Please refer to this certificate by number and market.

Figure 43 — Butter Grading Certificate Which Is Prepared From the Butter Grader's Memorandum.

of the shipment or consignment is determined by adding the net weights of all the churnings.

The grader should obtain all the information listed on the front of the Official Butter Grader's Memorandum (Figure 41), which is used in filling the heading of the grading certificate.

The grader is responsible for the accuracy of this information and he should check all the items with the firm that applied for the grading. The information on both sides of the memorandum is used in making the grading certificate after which it should be carefully preserved for future reference. Figure 43 shows a copy of a butter grading certificate properly made out from the data compiled on the Official Butter Grader's Memorandum. An original and as many carbon copies of the butter grading certificate as is necessary may be made.

CONSUMER GRADES OF BUTTER

Although many creameries establish brands for butter according to its quality, the placing of an actual grade or score upon the retail package of butter is not generally done. However, some states require consumer grades of butter. California[2] requires that all butter sold or distributed in retail packages shall be classified into grades indicating its quality and shall be labeled and advertised by the use of one of the designations as first, second, third and fourth quality. Butter in these quality designations shall not score less than 92, 90 to 92, 88 to 90, and less than 88, respectively. Fourth quality butter scoring less than 88 must be labeled with the words "for cooking and baking purposes only."

Oregon,[12] likewise, recognizes consumer grades of butter. Three grades of butter, A, B and C, scoring 92, 90 to 92, and 88 to 90, respectively, are permitted.

It must be borne in mind that packaged butter displayed in show cases and refrigerators is generally exposed to more unfavorable atmospheric and temperature conditions than prevail in wholesale storage. The chance of packaged butter deteriorating in stores sufficiently to lower its grade is possible but unlikely. The butter is scored usually at the time of packaging. Certificates of quality indicating the score or grade may be inserted with the butter. The United States Department of Agriculture certificate of quality is perforated to indicate when the butter was graded.

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Review Questions

1. On what basis is wholesale butter generally sold?
2. Distinguish between the six kinds of butter.
3. What are the quality classes of butter as determined by score?
4. Identify the five United States letter grades of butter.
5. What is the general make-up of the score card used in judging butter?
6. What is meant by the term "tempering" and why is it so important in butter judging?
7. List the desirable body characteristics of butter.
8. Distinguish between the term "body" and the term "texture" as applied to butter.
9. List the body and texture defects which may be found in butter.
10. What are the characteristics of flavor of high-scoring butter?

11. If a sample of butter had a cooked flavor, in what score or grade would you place it?
12. List the flavor defects and conditions causing butter to be classified as "No Grade."
13. What is a general rule for determining United States grades of butter? Give an example of this rule.
14. What are the limitations in deductions in body, color and salt in each flavor rating according to the federal grading system?
15. List the body defect intensities which merit a deduction of one-half point, one point and two points.
16. List the color defect intensities which merit a deduction of one-half point, one point and two points.
17. List the salt defect intensities which merit a deduction of one-half point, one point and two points.
18. On the percentage distribution basis, what body and texture defects were noted in the butter used in the Students' National Contest in the Judging of Dairy Products from 1926 to 1939, inclusive?
19. On the percentage distribution basis, what flavor defects were noted in the butter used in the Students' National Contest in the Judging of Dairy Products from 1927 to 1938, inclusive?
20. Indicate how you could distinguish between two flavor defects of butter.
21. How would you distinguish between "woody" and "storage" flavors of butter?
22. In the final analysis, how is a score or grade placed on a sample of butter?
23. How do the various authorities agree on flavor score or butter rating for various flavor defects?
24. What is meant by consumer grades of butter?
25. Why is package disregarded in the federal grading system?
26. List all the flavor defects and flavor defect intensities allowed in each alphabetical grade of butter.

CHAPTER VII

JUDGING AND GRADING CHEESE

The cheese judge is often called upon to judge or to grade one or more varieties or types of cheese. In order to be proficient he must have a working knowledge of the characteristics of cheese and know the desirable and undesirable qualities of each specific type.

The processes involved in cheesemaking are so varied that often the end products have little resemblance to each other. In general, cheese is a dairy product made by coagulating either whole or skimmilk, eliminating a large part of the liquid portion and retaining the entrapped or coagulated solids. The coagulated solids may or may not undergo subsequent ripening. The eliminated liquid portion, known as "whey," consists chiefly of lactose and water with minor percentages of ash, albumin, fat and casein. The solid or semi-solid portion remaining after the whey is eliminated is known as "curd." The milk solids in the curd made from whole milk are composed chiefly of casein and fat, with some ash, lactose and albumin present. The milk solids in the curd made from skimmilk have about the same relationship with each other as in whole milk curd except that only a very small amount of fat is present. The relative amounts of the various milk solids present, in proportion to the amount of whey retained in the curd, have much to do with the flavor and body characteristics of the finished product. Likewise, chemical changes resulting from controlled growth of various specific micro-organisms during the ripening process yield certain desired characteristics in the cheese. Thus, many types, varieties and kinds of cheese result with which the cheese grader must be familiar.

The cheese judge should become acquainted with the flavor and body and texture characteristics of the different kinds of cheese, and with their normal appearance and finish. Much can be learned about the quality of cheese by its appearance. By careful observation of the external appearance and by close ex-

amination of the internal body and texture and color characteristics, an experienced cheese judge can often place a cheese into its general quality class without tasting it.

Kinds of cheese. As previously mentioned, there are many different kinds of cheese, depending upon (a) whether it is made from whole milk or from skimmilk; (b) the method of coagulation of the milk; (c) the amount of whey retained in the curd; (d) whether the curd is ripened or unripened; and (e) the method of ripening. Milk coagulated by developing lactic acid in it yields a curd having a rough, grainy texture, while rennet coagulation yields a curd that is more pasty and pliable. The relative softness or hardness of the cheese depends upon the amount of whey retained in it. Soft cheeses made from whole or from skimmilk, which derive their flavor mainly from the lactic culture used and the cream added, are generally consumed while fresh. Hard or semi-hard cheeses are generally made from whole milk coagulated by rennet and are usually ripened or aged before they are consumed. Cheese also differs according to the bacteriological treatment of the milk before coagulation or according to the addition of proteolytic and lipolytic mold cultures added to the curd before pressing.

The cheeses on which methods of judging and grading are described in this chapter may be classified according to Thom and Fisk (1925) as follows:

Group I — Not ripened (45% to 75% water)
1. Cottage cheese
2. Neufchatel cheese

Group II — Ripened
- A. Soft cheese (40% to 50% water)
  1. Camembert
- B. Semi-hard cheese (38% to 45% water)
  1. Brick cheese
  2. Blue-veined cheese (Roquefort type)
- C. Hard cheese (30% to 40% water)
  1. Cheddar
  2. Swiss

CHEDDAR CHEESE

Cheddar cheese is a hard, ripened cheese made from raw or from pasteurized whole milk to which a small amount of lactic

starter has been added. The curd formed by the addition of rennet is hardened upon heating. The characteristic body of cheddar cheese is developed by a process of matting the curd, known as "cheddaring." The curd may be pressed in many different styles of hoops. After removal from the hoops the cheese is dried and dipped in hot paraffin to give it a protective coating.

The method of coagulating the milk, cooking and cheddaring the curd and the ripening conditions impart definite flavor, body and texture characteristics to the finished product. Cheddar cheese is sometimes called "full cream cheese" because it is made from whole milk from which none of the fat has been removed.

Degree of ripening. Much of the American cheddar cheese is marketed immediately after its manufacture. Consequently, it may be found on the market in all degrees of ripeness or cure. The ripening of cheddar cheese to develop the characteristic cheddar cheese flavor is a slow bacteriological, chemical and enzymic process which requires many months. For best results, ripening should be done under controlled temperature and humidity conditions. Some of the cheese marketed as soon as it is made is held under so many different temperature and humidity conditions in transit and storage that it does not ripen properly.

Unripened cheese is known as "fresh" or "green" cheese. This cheese has a flat, curdy flavor and a tough, corky body. Cheese that has been properly cured for about three months has a mild, slightly nutty cheddar cheese flavor, and is therefore referred to as a "young" cheese. At six to eight months of age more of the cheddar flavor should be present. Such cheese may be considered as "semi-aged" or "medium" cheese. Generally, it requires about a year to develop the full cheddar-cheese flavor desired in an "aged" cheese.

Whether the flavor of cheddar cheese is mild or pronounced does not depend entirely on the age. The quality of the milk, the bacteriological and chemical control in manufacture and the temperature of curing have much to do with the type and intensity of flavor in the cured product. However, the development of cheese flavor is so dependent on age that it is not advisable to judge cheese of all ages in the same class. In educational cheese

Table 16 — Common Styles of Cheddar Cheese

Style	Shape	Size of hoop Diameter inches	Height inches	Approximate weight in pounds
Cheddar	Cylindrical	14 ½	11 ¼	70–78
Twins	Cylindrical	14 ½	5 ¼	32–37
Daisy	Cylindrical	13 ½	4 ¼	20–22
Longhorn	Cylindrical	6	13	12–13
Young Amer.	Cylindrical	7	7	10–12
Jr. Twins[1]	Cylindrical	9 ¾	5	11–12
Square Prints	Rectangular	14 x11 x3 ¼		20
Square Prints	Rectangular	11 x 7 x3 ¼		10
Square Prints	Rectangular	11 x 3 ½x3 ¼		5
Square Prints	Rectangular	5 ¼x 3 ½x3 ¼		2 ½

[1] Also known as Family Twins, Pets, or Commodores.

Table 16a. — Summary of U. S. Grades of Cheddar Cheese*

Grade	General description	Numerical score range
U. S. Grade AA or U. S. Fancy	Cheese free from defects in flavor, body, and texture, and color, and practically free from defects in finish or appearance.	93 or above
U. S. Grade A or U. S. No. 1	Cheese with minor defects in flavor, body, and texture, and color, and finish or appearance but not to the extent the commercial qualities have been jeopardized.	91 to 92 inclusive
U. S. Grade B or U. S. No. 2	Cheese with pronounced defects that have affected or will affect the commercial quality as well as the keeping quality.	88 to 90 inclusive
U. S. Grade C or U. S. Undergrade	Cheese with serious defects but suitable in some channels of trade for immediate use, and the quality such that it will deteriorate rapidly in storage.	Below 88
No Grade	Cheese that has deteriorated in quality due to defective finish or having extremely serious defects in flavor, body and texture or color. It may or may not be edible.	

* Standards for grades of cheddar cheese will be found in the Appendix.

exhibits where the cheese is to compete for prizes, the cheese should be entered in different age classes. Young cheese under four months old, semi-aged cheese four to eight months old, and aged cheese over eight months old are logical age classifications.

Form. American cheddar cheese is marketed in several forms or shapes, called styles, any of which might well have been made from the same lot of curd. The common Wisconsin state standard styles of cheddar cheese are given in Table 16. The judge will be little concerned with the style of the cheese, except he may find that the larger size styles are not as subject to drying out as the smaller ones and this may slightly affect the texture and flavor of the cured cheese. The general description of the various U. S. grades of cheddar cheese are given in Table 16a.

The cheddar cheese score card. The score of cheese is determined by comparing the cheese qualities with standards of perfection for those qualities. These standards of perfection, when assembled, are known as the score card. On it are listed the essential factors or items by which the cheese is judged. These items are given an evaluation showing the relative value of each one. To the amateur cheese judge the score card is part of his judging equipment and as such should be studied in detail. The experienced judge keeps in mind the value of the items shown on the score card that are considered in grading. Recorded below are summarized score cards for American cheddar cheese. The American Dairy Science Association score card is the one used in training students in the judging of cheese and that which is used in the Collegiate Students' International Contest in the Judging of Dairy Products. The score cards differ in the evaluation of the several factors. The discussion in this chapter on scoring cheddar cheese is based on the American Dairy Science Association score card.

Factors	Perfect score as presented by			
	(Amer. Dairy Sci. Assoc.)	(Thom and Fisk)	(Fryhofer and Potts U.S. Dept. Agr.)	(Van Slyke and Price)
Flavor	45	50	30	45
Body and texture	30	25	40	30
Finish and appearance (or makeup)	15	10	20	10
Color	10	15	10	15
Total	100	100	100	100

Tempering cheese. Before cheese is scored, it should be tempered by holding it in a room at a temperature of 50° F. to 60° F. (10° C. to 15.5° C.) for a sufficient length of time to secure a uniform temperature throughout all parts of the cheese. This will require a few hours for the smaller styles and several hours for the larger ones. A plug taken from a warm cheese appears weak bodied, while a plug from a cold one will appear brittle or corky. The true body and texture characteristics cannot be determined unless the cheese is properly tempered before scoring.

Preparation for scoring. The same facilities for sampling, for proper disposal of the waste cheese, and for cleaning the cheese trier, should be provided for cheese scoring as is done with butter. The hands should be washed just previous to sampling, since they come directly in contact with the open cheese surfaces. As soon as the samples of cheese to be scored are arranged in order and numbered for proper identification, the work of scoring may begin.

Sequence of Observations

Appearance. The technique of cheese scoring is not radically different from that of butter scoring. The first procedure in the scoring of cheese is the examination of the finish or make-up. Standing directly in front of the cheese, notice if the general appearance is neat and attractive or if the surfaces are uneven, unparallel, or rounded, known as "huffed." Look more closely at the surface and observe whether the bandages have even edges, and whether the coating of paraffin is smooth and free from cracks or blisters. Examine the surface for mold and, if present, note whether it is outside the paraffin or under it. Observe next the side of the cheese for cracks in the rind. Make a mental record of your observations.

Sampling. As with butter, the sample is taken with a two-edged, curved-blade instrument known as a cheese trier. The edges of a cheese trier are sharper than those of a butter trier. A trier that cuts a larger plug has an advantage over one of smaller diameter because it is much easier to detect the degree of openness and the color defects on the larger plug. A cheese trier with a five-inch cutting edge, five-eighths of an inch in diameter at the base and 9/16 of an inch in diameter at the tip is recommended. The trier should be inserted into the cheese from the top, about half way between the center and the outer

edge. After the cheese trier is inserted it should be turned one-half around and withdrawn, bringing with it a long piece of cheese known as a "plug." The upper one inch of the plug should be broken off and replaced flush with the surface in the hole from whence it was drawn. This partially protects the cheese from mold contamination and retards drying and cracking of the rind surrounding the hole. The surface plug should be replaced as quickly as possible, but not until the plug has been passed slowly under the nose to ascertain the aroma. The practice of passing the plug of cheese under the nose immediately after sampling should become a part of one's scoring technique. After replacing the surface end, examine the remainder of the plug very closely. Note whether the plug has a clean-cut surface with no loose particles or whether it is rough, having a feather-like edge as though the cheese had been cut with a dull knife. Make a mental note of your observations.

Color. Observe the color and determine whether it is bright and clear or dull and lifeless in appearance. Notice also if the color is uniform and free from mottles or light and dark portions, or if it has seams or faded areas surrounding the mechanical or press holes. Re-examine the plug again and observe whether the cheese appears to be translucent or whether it is opaque, thereby not permitting the eye to observe beyond the surface. Note if the color is uniform throughout. Uniformity of color is far more important than shade of color. Some consumers prefer an uncolored cheese which is of a light cream shade.

Openness. Observe the nature and extent of the openings in the cheese. Examine them closely to see whether they are regular, angular, rounded, large or small. Observe also the luster or shine of their inner surfaces and note if they are dry or wet.

Texture. Take the ends of the plug by the forefingers and thumbs of the two hands and bend the plug slowly into a semicircle, observing meanwhile both when it breaks and the nature of the break. Observe carefully whether the plug shows a resistance toward bending and finally breaks suddenly, or bends greatly and eventually tears apart slowly.

Take one of the broken pieces between the thumb and fingers and work it up into a uniform mass, observing its resistance to the pressure of the thumb and fingers. Spread the mass thinly

over the palm of the hand with the thumb and observe whether the mass feels smooth, silky, waxy, and fine or whether it is sticky, pasty, mealy, or crumbly. Reassemble the particles, compress them into a ball, noting meanwhile the response of the cheese to this manipulation.

Aroma. By the time the sample is worked into a semi-soft ball, the temperature of the mass will have been raised by the pressure and by the heat of the hand enabling easy detection of the aroma. Place the worked mass under the nose and observe the aroma.

Compare this aroma with that noted when the sample was first removed from the cheese. Place a small portion of the unworked plug into the mouth and chew it up to a semi-liquid. Roll it about in the mouth, expectorate it, and observe the flavor. Since cheese tends to obscure the sense of taste, a great many samples should not be tasted at one scoring, for they will soon begin to taste alike. However, a number up to about ten samples can be tasted successively by a beginner with a fair assurance that the nerves of the sense of taste are functioning normally. Rinse the mouth occasionally with lukewarm water containing a little salt, which cleans the mouth satisfactorily of previous cheese flavors. A pinch of common table salt placed in the mouth and rinsed out with tepid water is equally effective. An experienced cheese judge can generally grade cheese by the appearance, color, amount and nature of openness, texture and aroma of the worked mass. He may taste an occasional sample to verify his judgment.

The smelling and tasting of the cheese completes the scoring technique. The results should now be recorded on a score card provided for that purpose. The beginner should strive to follow this technique very closely. The use of the score card is much less tiresome and more accurate when a large number of samples are judged. The beginner should also strive to keep in mind or "see" each cheese as readily as though they were so many different specimens. Once this ability is attained it is unnecessary in scoring a class of ten samples to re-examine continually the various samples. The practice of re-examining, reworking, and retasting cheese is not conducive to the best scoring. Such a practice leads to vacillating judgment, which is just as apt to be wrong as to be right.

REQUIREMENTS FOR HIGH GRADE AMERICAN CHEDDAR CHEESE

Color — 10 points

The color of the cheese, whether it is high or low, should be uniform throughout. American cheddar cheese may be uncolored, medium colored, or high in color. The most desired color is a very light straw for the uncolored or natural color cheese and a deep straw or amber for the medium colored cheese. The deep, intense shades of yellow or those having a reddish hue are discriminated against. Not only should the shade of color be proper and carried uniformly throughout, but the color should exhibit some "life." The cheese should be slightly translucent; that is, it should appear as if one could actually see into the cheese for a short distance. The translucent quality of cheese is closely associated with a desirable body and texture.

Color has the lowest rating of the four items which comprise the cheese score card. However, this does not indicate that the color of cheese is not important. Not only is color one of the items capable of being most accurately evaluated, but when carefully observed and correlated, may also serve as an index to other defects in body, texture, and flavor. The normal range of score on color of American cheddar cheese is 9 to 10.

Color Defects and Their Characteristics

Some of the color defects associated with American cheddar cheese are as follows:

Acid-cut	Mottled
Bleached	Seamy
Faded	Unnatural
Foreign color specks	Uneven
High	Wavy
	White specks

Acid-cut, bleached, faded. These color defects are similar, differing chiefly in their intensity. The color of such cheese appears dull and lifeless, so slightly translucent that very little light will be transmitted through even a thin slice. The acid-cut color may often be noted uniformly throughout a portion of or the whole cheese (Figure 44). In some cheese the acid-cut color may be noted only immediately surrounding the press or mechanical openings. In such cases the cheese may have a mottled ap-

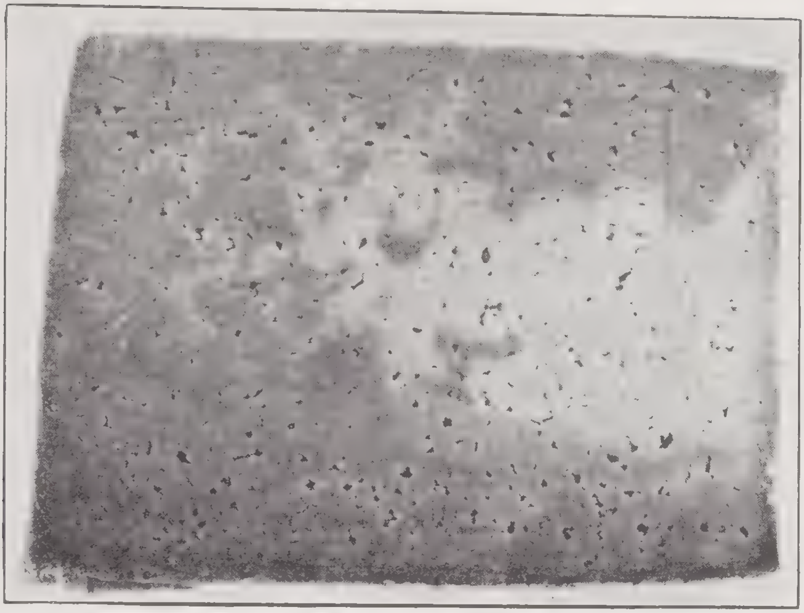


Figure 44 — An Excellent Example of an Acid-cut Cheese. Small Mechanical Holes Also May Be Noted.

pearance. Of the two defects, a uniform acid-cut color is to be preferred; however, neither is desirable. The judge should readily recognize this color defect and be on the alert for a possible association with a body and texture or a flavor defect. Generally an acid-cut, faded color is associated with high moisture and high acid, but it may be observed sometimes in a cheese with a dry body and a crumbly texture. Cheese showing this defect practically always has a high-acid or sour flavor. The acid-cut color probably occurs more frequently than any other color defect of cheddar cheese (Figure 45).

Foreign color specks. Foreign color specks in cheese vary in nature from occasional white or black specks to rust spots and red blotches. While there may be little association between these foreign color specks and any specific off-flavor, their presence in cheese is not tolerated.

High, unnatural. This color defect is characterized by a very deep yellow color which may often have an orange-yellow hue, especially when the cut cheese is warmed up to room temperature or higher. There is no association between this color defect and the flavor, since it usually is due to the addition of an excessive amount of color in the cheese milk. Highly colored cheese may be preferred in some markets, but it is usually discriminated against.

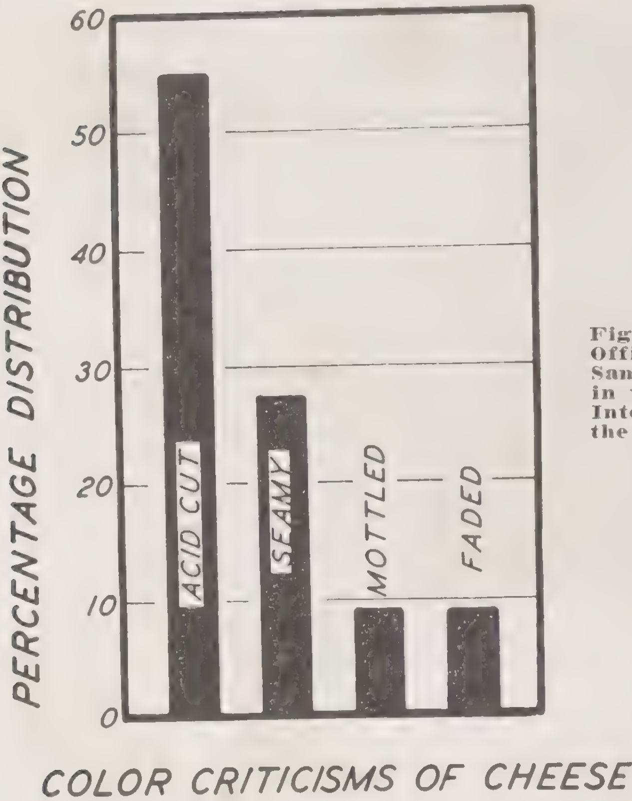


Figure 45 — Distribution of Official Color Criticisms on Samples of Cheese Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1926 to 1936, Inclusive.

Mottled. The mottled color defect appears as rounded, irregularly shaped areas of light and dark shades of color, the one shade gradually blending into the other (Figure 46). The defect may result from physical causes in manufacture or to microbiological changes during the curing process. Chief causes usually ascribed to this defect are combining the curd from two different vats or to uneven development of acid in the curd. When the mottled color is the result of microbial growth, this color defect is frequently associated with a yeasty, fruity, or an acid flavor and a pasty body.

Seamy. Seamy cheese appears interlaced with light colored lines around each piece of curd (Figures 47 and 48). This is particularly noticeable when looking squarely at the surface of freshly cut cheese. This color defect results from altered curd surfaces such as exuded fat or drying prior to pressing. Cheese showing this color defect not only lacks uniformity of color, but may contribute to a short-bodied, crumbly or friable texture

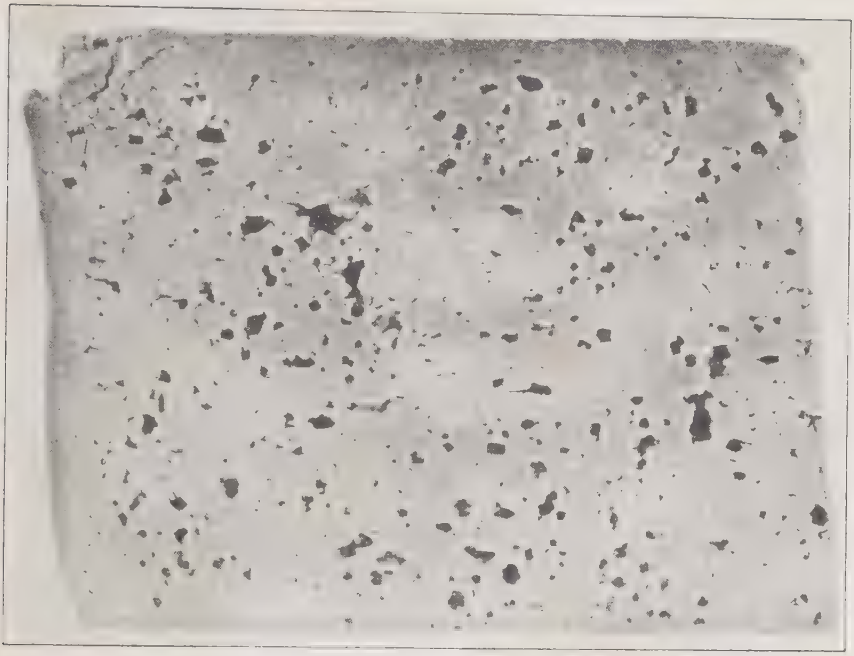


Figure 46 — A Cheese With Mechanical Holes Which Also Shows Mottled and Acid-cut Color.

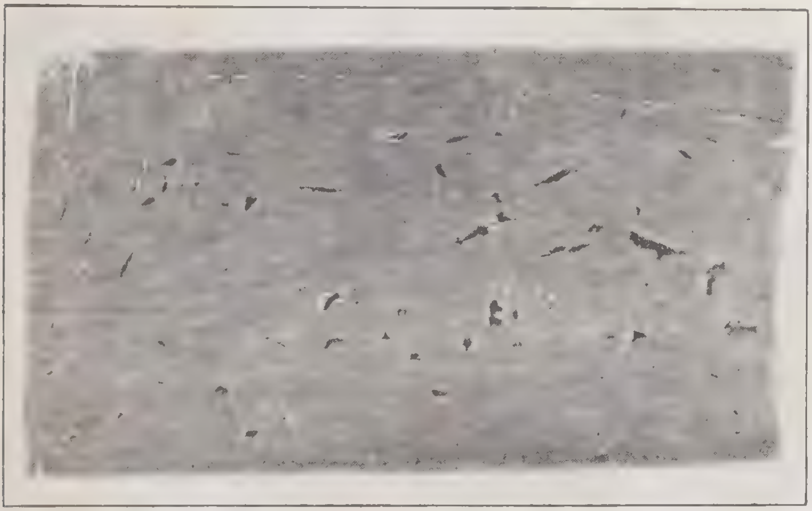


Figure 47 — A "Seamy" Cheese Having Slit-like Openings. Such a Cheese May Show a Short or Flaky Body.

cheese. The slightly seamy color sometimes noted in fresh cheese is not particularly objectionable.

Uneven, wavy. Cheese having this defect is easily recognized. The defect is generally continuous as contrasted with the spotted effect noted in a mottled cheese. The uneven, wavy color may

Figure 48 — The Interlacing White Lines Represent a Color Defect Known as "Seamy." The White Specks Which Are Frequently Found in Aged Cheese Are Not Objectionable.

result from layers of curd from two different vats or lots, or may be due sometimes to localized development of the bleached, faded, or acid-cut color. When the defect is due to mixtures of curds from different lots there is likely little correlation between the color defect and any specific flavor defect.

White specks. Cheese having this defect is intermixed throughout with tiny white specks which have been found to have all the chemical characteristics of the amino acid, tyrosine. Sometimes these white specks are so small that they are noticeable only when viewed from a short distance. This color defect is commonly associated with aged cheese (Figure 49), but may be noted in medium cured cheese also. The accumulation of tyrosine would indicate that the cheese has been aged long enough for the casein to break down, yielding this amino acid. Aged cheese showing this color defect usually has a desirable buttery body. This would again indicate the breakdown of the casein. The amateur judge should associate this color defect with an aged cheese which should have a well developed flavor. White specks are not considered a serious color defect. Their presence may be noted but a deduction in score is not made.

Figure 49 — An Excellent Example of White Specks in Cheese. This Two-and-One-half-Year Aged Cheese Has an Excellent Smooth Silky Body. The Rounded Holes Suggest Possibility of Sweet Curd Holes During the Early Storage Period.

Finish and Appearance — 15 points

Cheese with a desired finish should show flat, parallel ends; square, even edges; an evenly-folded, neat, close-fitting bandage free from wrinkles; a clean, thin, uniform, close-adhering coating of paraffin, showing no blisters or scales; and freedom from cracks, mold, rot spots, or soiled areas.

The finish of the cheese is important in judging and grading cheese as it furnishes an indication of the skill and care taken by the cheesemaker during manufacture of the cheese and of the subsequent handling of the product. An ill-shaped, carelessly bandaged and poorly-finished cheese indicates carelessness in manufacture which may be correlated with a low flavor quality. An untidy, soiled, or moldy cheese does not present a pleasing appearance to the consumer. Defects in finish are not difficult to observe. As a general rule, cheese most frequently scores perfect in finish and appearance and is, therefore, given the full 15 points. When defects occur, the normal range of score on the item is from 14 to 15 points.

The beginner should become familiar with the following defects in finish and correlate them, if possible, with other defects. The following defects are closely associated:

1. Paraffin.

a. Blistered. This defect manifests itself by areas of thin, loose paraffin chiefly on the ends of the cheese where the cheesecloth may be absent. Such a condition lends itself well to the entrance of mold and for the harboring of cheese pests and is, therefore, very objectionable.

b. Checked. A checked or cracked paraffin is exhibited by breaks or cracks in the covering of the cheese. This defect is usually caused by the coating of paraffin being heavier than is necessary. The checked paraffin offers an opportunity for mold and pests to gain entrance to the cheese.

c. Rough. Rough paraffin is shown by a lack of smoothness on the surface. The paraffin seems to have small hard particles in it, thus giving the impression that the surface of the cheese may have been covered with tiny specks of foreign matter prior to paraffining. This defect is not serious but is not desired in high-scoring cheese. The defect may be detected by the eye or by running the hand over the surface.

d. Scaly. Loose or scaly paraffin (Figure 50) is at best a very poor protection for cheese. It permits moisture to escape and mold to gain entrance and is, therefore, a serious defect. In cutting the cheese, particles of paraffin often become intermixed with the cheese itself, thus pre-

senting an untidy, unappetizing slice. Scaly paraffin should seldom occur, if cheese is dried sufficiently, then completely dipped in hot paraffin not lower than 220° F. (104.4° C.) for at least ten seconds, and the paraffin allowed to harden completely after the cheese is removed from the dipping tank. This is one of the more common finish defects of cheddar cheese (Figure 51).

2. *Workmanship.*

a. High edges. Cheese showing this defect lacks the square edges desired in a well finished cheese. Sometimes

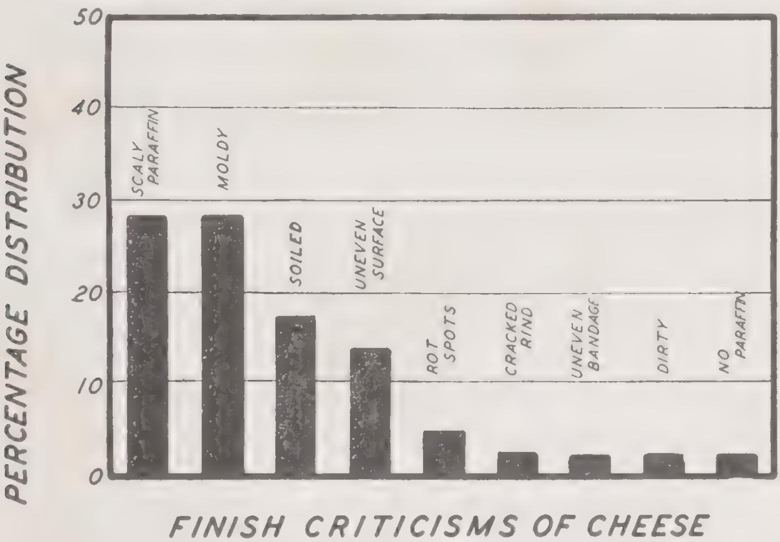


Figure 51 — Distribution of Official Finish Criticisms on Samples of Cheese Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1926 to 1936, Inclusive.

the edges are so high that they bend over onto the end of the cheese, thus forming a protected area for mold growth or for pests. The high edge is usually dry, does not cure properly and thus represents waste, as it is inedible.

b. Lopsided, misshapen. A misshapen cheese is characterized by its nonparallel ends as a result of uneven distribution of the curd in the hoops, together with unequal pressure in the press. It is not desirable because it detracts from a neat appearance. This make-up may sometimes be correlated with a weak-bodied cheese. Sometimes a weak-bodied, longhorn-style cheddar cheese lying horizontally on the shelf tends to flatten somewhat when ex-

posed to higher temperatures. Cross section cuts of the semi-flattened cheese reveal an ellipsoidal form rather than the desired circle. In reality this is a misshapen cheese, but one that has resulted from the weak body defect rather than caused by carelessness of the cheese-maker in hooping and pressing the curd.

c. Uneven edges. Heavy pressure in the press against followers or press boards that are too small may cause the curd to squeeze out around the edges and form a narrow raised edge or rim around the outer edge of the cheese, generally about one-half inch thick. The presence of these raised, uneven edges not only detracts from the appearance of the cheese, but is a waste of curd in that the raised edge dries out and does not cure properly. Cheese should be pressed so that the edge of the cheese meets squarely with the sides.

d. Uneven sizes. The cheese of a designated style should be well within the weight tolerance for that style of cheese. Lack of uniformity of size presents an unattractive appearance. Carelessness in distributing the amount of curd among the various hoops evenly may often be correlated with other defects.

3. Rind.

a. Cracked rind. This condition is due to several causes, among which are those associated with improper drying of the cheese after it is removed from the press. Cracks occur more readily when the bandage is torn or loose, when the cheese is held too long in the drying room

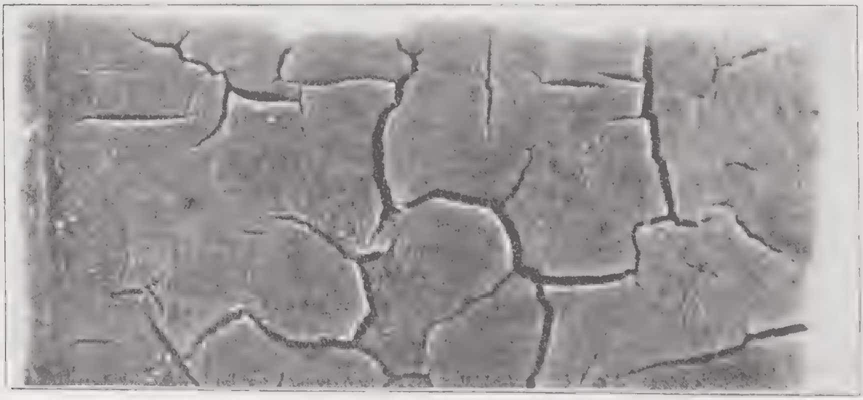


Figure 52 — Cheese With Cracked Rind.

before paraffining, or when the cheese is not paraffined at all. When cracks are present, they are usually observed on the sides (Figure 52), where the greatest pressure is exerted. Frequently, small cracks or checks are observed on the ends, but usually these are not as deep as those on the sides. Any openings in the rind are serious as they allow the cheese to dry out, permit the entrance of mold and harbor pests.

b. Mold spots. This defect is characterized by occasional, tiny, scattered mold areas more generally on the end of the cheese than on the side. Mold growth is usually localized, which is probably due to the firm condition of the paraffin. The defect may be associated with or develop into the more serious rind-rot defects as the cheese ages.

c. Rind rot. Rind rot is a surface decomposition of cheese which is usually manifested by various sized, smooth-edged, irregularly-shaped, brown-colored areas. Examination of these spots reveals a soft, watery substance, the product of bacterial decomposition. The depth of these infected areas depends largely on the length of time they have been developing. This is a serious defect in cheese, inasmuch as the cheese adjacent to such spots is unsaleable and represents a waste. Cheese with rind rot is sometimes intensely bitter, particularly near the infected areas. If rind rot extends through the cheese, the cheese is a total loss.

d. Soft spots. Soft spots of cheese may be a forerunner of rind rot. The spots are usually colorless but are noticeable by their moist, water-seepage appearance and by exuded water from the loose paraffin. The defect is sometimes referred to as a water spot. This is a serious defect as the cheese adjacent to a water spot represents a loss. This condition may be correlated with a flavor defect.

4. *Bandage.*

a. Loose. A loose bandage on paraffined cheese is not common. However, a loose bandage on cheese prior to paraffining may be noted on the paraffined cheese by the folds in the bandage and by the heavy paraffin in.

around, and over the folds of bandage. In such cases, the bandage appears too large or too extensive for the cheese. The defect represents carelessness on the part of the cheesemaker.

b. Soiled. Soiled bandages are rather uncommon in cheese, but may be noted occasionally. They may have an even, gray appearance or may be spotty as though mildewed.

c. Torn. A torn bandage is not as readily noted as the nature of the defect would indicate, due to the fact that the torn bandage is paraffined down tightly. The torn bandage is objectionable in that it permits a non-bandaged area which is more liable to crack, thus exposing the cheese to infestation.

d. Uneven. An uneven bandage may be readily noted when the ends of the cheese are examined. The bandage may be longer on one side than on the other. This not only detracts from the appearance but often causes unnecessary overlapping on the cheese which may favor mold growth and subsequent rind rot.

e. Too much overlap. As with the uneven bandage, this defect may be observed when the cheese is examined from the end. The bandage may be evenly placed, but it is too long for the cheese. An evenly placed bandage should overlap the edge about one inch.

f. Wrinkled. This defect may be noted, when present, by close examination of the cheese from the side. The bandage is tight, but a fold appears to be pressed into the cheese. The wrinkled bandage results from failure to dress or from improper or careless dressing of the cheese. A wrinkled bandage not only detracts from the appearance of the cheese, but it may furnish a focal point for mold contamination and pests. Mold growth not only detracts from the appearance of the cheese but it may result eventually in a moldy-flavored product.

5. *Surface.*

a. Bruised. A bruised surface is shown by slightly depressed areas over which the paraffin is broken. Cracks in the paraffin may radiate from the center of the break.

In addition, the paraffin may have been loosened from the cheese. A bruised surface permits mold contamination and pest infestation.

b. Light spots. A cheese exhibiting this defect has more or less irregular light and dark areas over the flat ends. The defect is noticeable but is not a serious one.

c. Moldy. Mold growth on cheese may occur on portions where the paraffin has been broken due to plugging, in cracks in the paraffin or from bandage contamination. Mold may also grow on the under surface of the cheese which is next to the shelf or next to the bottom of the cheese box. The presence of even a slightly moldy portion not only detracts from the appearance but may jeopardize the flavor of the entire cheese because as soon as the cheese is cut, the mold mycelia will have an opportunity to penetrate the entire cheese.

Moldiness is a serious finish defect and one which annually results in a considerable loss in the cheese industry. No uniformly successful method has been found to keep the mold from re-developing on moldy cheese treated with a fungicide or on cheese that has been cleaned, scraped and re-paraffined.

d. Open. An open surface is shown by short depressions on the surface. This is usually a result of insufficient pressure or cold curd at the time of pressing. The open surface reflects an open-texture cheese, showing many press or mechanical openings. The defect is objectionable because the depressions furnish good sites for harboring cheese pests.

e. Rough. A rough-surface cheese exhibits irregularities on the surface. The defect may result from unclean press cloths to which particles of dried curd have adhered, insufficient pressing or from rough uneven shelf boards. The cheese showing this defect lacks an attractive appearance.

f. Soiled, unclean. Dirt on or under the bandage or in the paraffin, which is due to carelessness on the part of the cheesemaker, gives the cheese an untidy appearance. A cheese held at high temperatures will liberate

some of the fat through the paraffin which collects dust, thus giving the surface of the cheese a greasy, unclean appearance. Mold may also grow on this liberated fat and the mold mycelia penetrate through the fat down into the cheese, resulting in a moldy flavor cheese which eventually results in a total loss.

6. *Miscellaneous factors.*

a. Cheese mites and "skippers." Cheese mites are usually manifested by a very fine, loose, brown dust on the surface of old cheese, on the shelves, or in the cheese box. Microscopic examination shows this brown dust to be composed of live and dead bodies, molted skins, excreta, and of minute particles of cheese and refuse. In badly infested cheese which has not been moved for some time, the brown dust may appear over extensive areas of the cheese, but it is more generally localized in favorable harboring places, such as in cracks, under a folded high edge, or under scaly paraffin. Obviously, the presence of cheese mites represents a loss to the cheese industry. "Skippers," the larvae of the cheese fly, may be readily noted.

b. Huffed, bloated. A huffed cheese results from a gassy fermentation. A cheese with this defect is usually rounded on the sides and ends, thus having somewhat of an oval shape. As the cheese rests upon the shelf, the lower edges are raised slightly off the shelf. Occasionally the gassy condition develops to the extent that the general symmetry of the cheese is distorted and the bandage is broken. A huffed cheese yields an open plug which is full of gas holes. If the cheese is stored at a low temperature it tends to flatten out and to assume its original form. A plug of such cheese is characterized by openings in the form of narrow slits, called "fish eyes" by the cheese judge. A cheese that is or has been huffed is always a low-scoring cheese as it is subject to all the off-flavors that accompany the gassy fermentation.

c. Ink smears. The presence of ink smears, resulting from carelessness during branding of the cheese, detracts from the appearance of the cheese. This is a minor

defect which, obviously, cannot be correlated with other defects.

d. Rust spots. Rust spots on the surface of cheese are not common. The defect may be caused by careless driving of nails longer than necessary when tagging the boxes. Usually the defect is associated with a punctured bandage. The rust spot is objectionable because it represents a waste area and because the puncture furnishes a focal point of contamination.

Body and Texture — 30 points

The desired body and texture of cheddar cheese is that which yields a full, solid, close-knit plug possessing smoothness, meatiness, waxiness and silkiness and which is entirely free from gas holes.

The term "body" as applied to cheese, refers to the various qualities which affect the firmness of the cheese. The term "texture" refers particularly to the structure and arrangement of the parts which make up the whole. As a general rule, the close or medium close textures are preferred; however, no discrimination is made against a slightly open texture, providing the body is such that the open texture does not give rise to a weak cheese. A close-textured cheese yields a solid plug with practically no openings whatsoever (Figure 53). The plug, however, may break

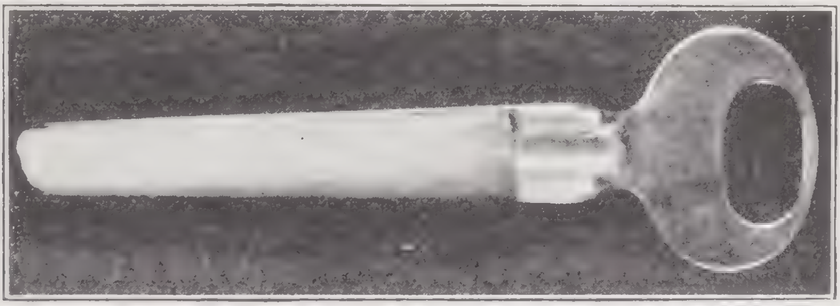


Figure 53 — A Good Cheese Yields a Full Plug With a Sharp, Clean-cut Surface.

along a seamline. The plug of a medium close-textured cheese shows the presence of a few openings which may have been caused by insufficient matting or pressing of the curd or both. An open cheese yields a full plug which may contain numerous large or small irregularly shaped openings referred to as "mechanical holes." Plugs from cheese of various qualities are shown in Figure 54.

The beginner should experience no difficulty in identifying body and texture defects, once he gets the desirable and undesirable body and texture characteristics in mind. Although body and texture are sometimes given the full rating of 30 points, ordinarily they do not merit such a high rating. The normal scores on body and texture range from 26 to 29.5 points.

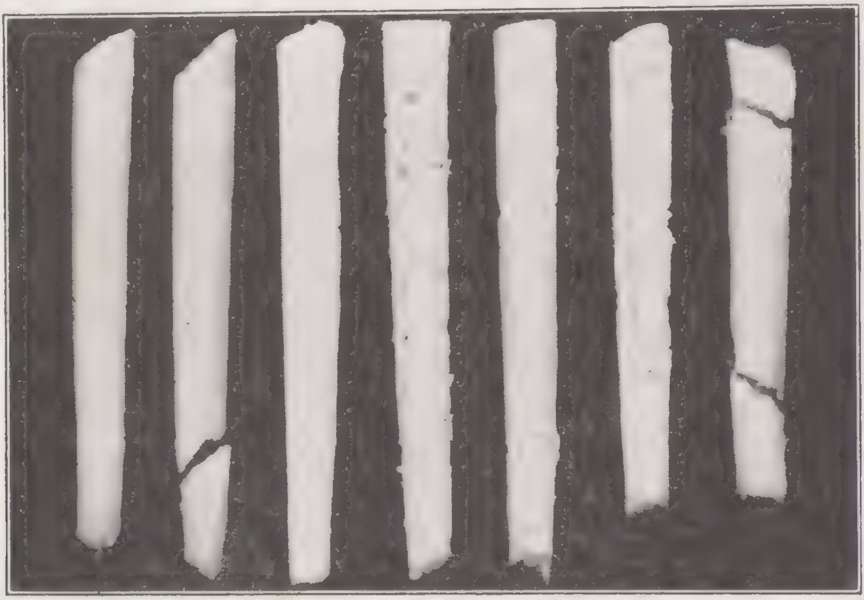


Figure 54 — Plugs From a Class of Cheese of Various Qualities. Note the Difference in the Bore of the Different Plugs. How Should This Class of Cheese Be Placed? Number the Plugs From Left to Right.

Desirable Body and Texture Characteristics

Firm body. Cheese with a firm body feels solid and offers a slight resistance to pressure. Such cheese yields a clean-cut plug which tears apart slowly on bending rather than breaking suddenly (Figures 55 and 56). The texture is usually close, and the curd particles well matted. A slice of firm cheese tends to tear like the breast meat of a chicken. A firm body must not be confused with a dry, corky, or curdy body, which often resists pressure to the extent that this cheese seems springy.

Waxy body. A waxy body is exhibited in cheese when a plug responds to the pressure of thumb and fingers about the same as if it were cold butter. In breaking down the cheese little resistance is offered other than the normal resistance necessary to change the relationship of the particles which make up the texture. There is very little tendency shown by the cheese to

Figure 55 — A Plug of High Quality Cheese. Note the Smoothness of the Bore and the Manner in Which the Plug Bends. The Plug Was Taken From a U. S. Extra Fancy Cheese Scoring 96.

spring back to the original position, but rather the cheese assumes the new form as a result of the pressure of the thumb. A waxy body is associated with medium aged or aged cheese and is a favorable indication of proper flavor development.

Silky, smooth texture. A smooth-textured cheese exhibits a fineness of grain and a continuous, oily, silky, smooth film when the mass worked between the thumb and fingers is spread over the palm of the hand. The worked cheese usually spreads evenly without rolling in patches. This spread out cheese may be reassembled readily into a ball. The smooth, silky texture is indicative of the proper flavor development.

Figure 56 — A Typical Break in a Plug Taken From a High Scoring Cheese. Such Cheese Breaks or Tears Apart Slowly Rather Than Snapping Apart. This Is the Same Plug as Shown in Figure 55.

Undesirable Body Characteristics

Many terms are used to describe the undesirable body defects of American cheddar cheese. They may be classified as follows:

(1) Corky, dry, hard, overfirm, stiff, tough
(2) Crumbly, friable
(3) Curdy, rubbery
(4) Flaky, short
(5) Greasy
(6) Grainy, gritty, lumpy, sandy
(7) Mealy, salvy
(8) Pasty, smeary, sticky, watery, wet
(9) Spongy
(10) Weak, soft

1. Corky, dry, hard, overfirm, stiff, tough. This defect is generally associated with a dry, low-fat or young cheese. Difficulty is sometimes encountered in sampling the cheese because of its resistance to the trier. The plug resists pressure and when sufficient pressure is applied the plug breaks down with a slight tendency to recover its original shape. The plug is stiff on bending and has a slight, rubber-like elasticity. When a portion of a plug of cheese bearing this defect is worked between the thumb and forefingers, the smooth, silky, even distribution of the cheese particles is lacking. The worked mass of cheese tends to curl up under the sliding pressure of the thumb over the forefingers and is distributed in irregular patches. This defect may be associated with other body defects of which dryness is a closely related factor. A dry-bodied cheese is generally opaque. It may also exhibit a seamy or an acid-cut color. Dry body and the high-acid flavor defect are often associated.

2. Crumbly, friable. A crumbly bodied cheese is one which tends to fall apart when sliced. Difficulty is encountered in securing a thin slice. A plug of such cheese often shows numerous breaks. Sometimes the cheese may be extremely friable. The defect appears to be closely associated with mealiness and with the acid-cut and seamy color. Such cheese may be dry, but more often will be normal in that respect.

3. Curdy, rubbery. This body defect is characteristic of freshly made, "green" or uncured cheese. Such cheese is firm,

almost hard. The plug resists pressure and when it yields to the pressure there is a tendency for the cheese to spring back to its original shape. A high positive correlation exists between a curdy, rubbery body and the fresh, "green," undeveloped flavor. Since curdiness is a characteristic of young, uncured cheese, before the curd has had an opportunity to break down, it is not a serious body defect.

4. *Flaky, short.* A flaky, short body is indicated by a lack of meatiness or of a closely knit texture. The plug which shows little elasticity, breaks easily, exhibiting a fairly even and a somewhat glistening surface. Cheese having this body defect is generally slightly dry and when worked between the thumb and forefinger is inclined to be mealy.

5. *Greasy.* A greasy cheese is one which has free fat not only on the surface but in and around the openings within the cheese and on the surfaces of the individual curds. The defect is easily recognized. Such cheese often exhibits marked seaminess.

6. *Grainy, gritty, lumpy, sandy.* When cheese worked between the thumb and forefingers lacks uniformity and smoothness and shows the presence of irregularly shaped, hard particles of cheese, it is criticized as gritty, grainy, lumpy or sandy, depending upon the size of the particles. This condition may be correlated often with a dry, corky body.

7. *Mealy, salvy.* When cheese worked between the thumb and forefingers is uniform, but feels like corn meal, and tends to spread in irregular patches under the sliding pressure of the thumb over the forefingers, it is described as mealy or salvy. A mealy cheese is one which is inclined to be dry and one from which the fat seems to be released readily. The cheese usually has a short body with little elasticity.

8. *Pasty, smeary, sticky, watery, wet.* Cheese showing this defect is usually characterized by the presence of high moisture, by the difficulty in securing a full, well rounded plug, and by the tendency for the cheese to become distorted in shape. The cheese breaks down easily into a pasty, sticky mass which tends to adhere both to the thumb and to the forefingers. This defect is closely associated with a weak body and with acid, fruity, or fermented flavors.

9. Spongy. A spongy-bodied cheese is one which fails to yield a full, continuous plug, due to the presence of gas or mechanical openings that prevent firmness in the body of the cheese. As the cheese is plugged, it tends to sink immediately next to the trier. Such cheese is springy when pressure is applied to the surface. The defect is commonly associated with a gassy, high-moisture, weak-bodied cheese.

10. Weak, soft. A weak-bodied cheese may be noted particularly by the small amount of pressure necessary to break the structure or to mash the cheese. Such a cheese is soft and always associated with high moisture. The weak body may be associated with fermented flavor defects. An aged, weak-bodied cheese usually has a fruity, whey taint, or some other undesirable flavor, enhanced presumably by the high moisture, or whey content.

Undesirable Texture Characteristics

The texture defects of American cheddar cheese may be classified into the following groups:

1. Fish eyes, yeast holes
2. Pin holes, gassy
3. Open, mechanical holes, porous, loose
4. Swiss holes, sweet-curd holes, shot holes

1. Fish eyes, yeast holes. Cheese made from milk or culture contaminated with yeast may develop round, glossy surfaced, gas holes as a result of a yeasty fermentation. Cheese which contains yeast holes usually has a "spongy" body due to excessive gas production. During plugging, the cheese tends to sink immediately adjacent to the trier. Such cheese usually yields a honeycomb-like plug. Yeast holes in cheese may flatten out as the cheese is cured, forming long narrow slits known as "fish eyes." (Figure 57.)

2. Pin holes, gassy. Gas holes in cheese vary in size, are fairly uniform in distribution and regular in shape. They are formed by the gas produced by the development of undesirable micro-organisms within the cheese. The seriousness of the gas holes found depends on the kind of organisms that form the gas. If the gas holes are about the size of a pin head and characterized by their regularly round form, even distribution, with a slight tendency to be more extensive toward the center, they are

Figure 57 — A Cheese With Narrow Slit-like Holes Known as "Fish-eyes." The Round, Smooth Openings Are Gas Holes.

called "pin" holes. "Pin" holes are the result of the growth of undesirable bacteria, that very definitely affects the flavor of the cheese. An objectionable fruity flavor is formed that limits the cheese to a low score. The presence of numerous "pin" holes and other gas holes may give rise to "huffed" cheese, especially if the cheese is cured at too high a temperature. If there are sufficient gas holes in cheese to weaken the body structure it is termed "gassy" and the body is referred to as "spongy." A "gassy" or "spongy" cheese usually has an undesirable flavor.

3. Open, mechanical holes, porous, loose. Open, porous, loose texture is manifest by mechanical holes, gas holes, or fish eyes or any combination of them. Mechanical openings are characterized by their irregular, angular shape and size, and by the dullness of their surface linings (Figures 58, 59 and 60). These holes result from various conditions in the matting and the pressing of the curd. There is little or no relationship between their presence and the flavor. As long as they are not connected and neither so numerous nor so large as to weaken the body, they do not meet with serious objection.

4. Swiss holes, sweet-curd holes, shot holes. The large, uniformly distributed gas holes found occasionally in cheddar

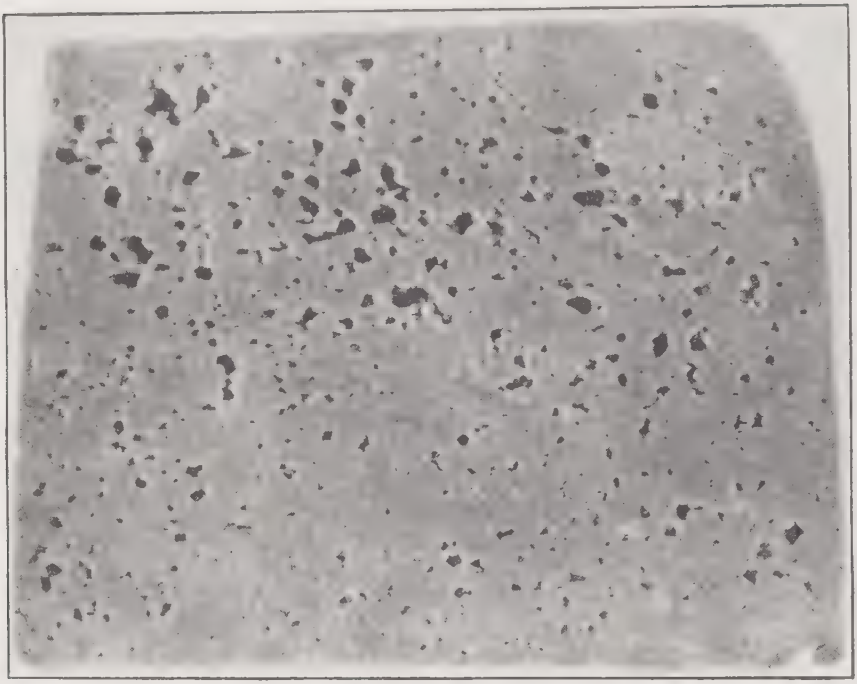


Figure 58 — A Cheese With Many Mechanical Openings.

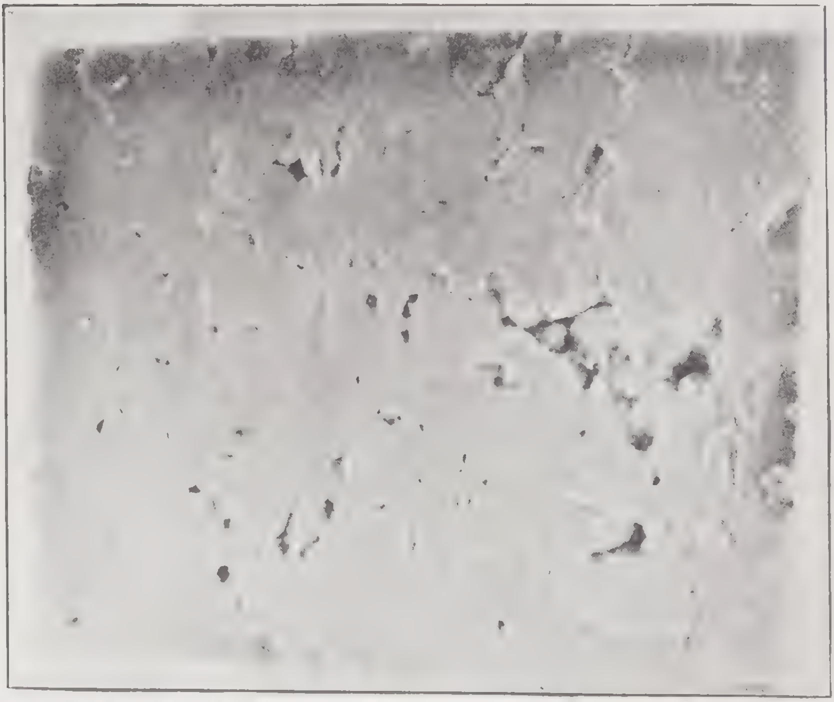


Figure 59 — An Aged Cheese Showing White Specks, Dry, Slightly Cracked Rind and Mechanical Holes. This Cheese Has a Very Waxy Body and a Smooth, Silky Texture.

Figure 60 — A Well-finished Cheese Showing Slight Seaminess and Mechanical Holes.

cheese are the result of a particular bacterial growth. There is a correlation between their presence and the flavor of the cheese. The large gas holes are associated with a peculiar, sweetish, pleasant flavor characteristic of Swiss cheese; consequently, they are referred to as "Swiss holes," "sweet holes" or "shot" holes (Figure 61). The characteristic flavor formed, although not a serious defect, is not a typical cheddar flavor.

Distribution of Body and Texture Defects of Cheese

The Committee on the Judging of Dairy Products of the American Dairy Science Association, 1941, made a study of the official body and texture defects of cheese used in the Collegiate Students' International Contest in the Judging of Dairy Products (Figure 62) from 1926 to 1939, inclusive. This cheese was scored by recognized cheese judges. Since several of the samples may have been selected for specific defects, the percentage distribution may not apply to commercial cheese as a whole. However, a knowledge of the prevalence and associations of certain body and texture defects encountered should be of some value to the beginner.

During the fourteen year period from 1926 to 1939, inclusive, 94 samples, or 90.4 percent, of the 104 samples of cheese used in the scoring contests were criticized on body and texture. A study

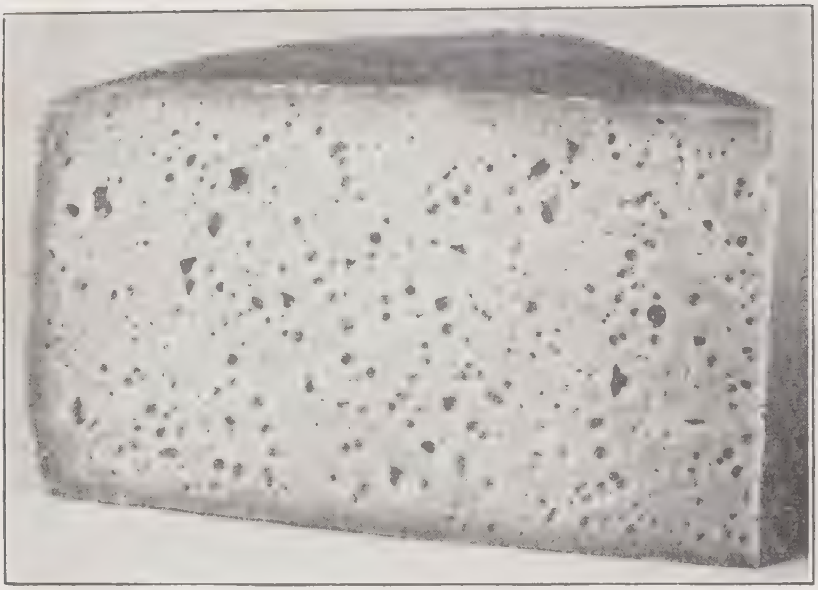


Figure 61 — A Cheese Definitely Showing Both Mechanical and Large Gas Holes, Probably Sweet Curd Holes.

Figure 62 — A Group of College Students Judging Cheese in the Collegiate Students' International Contest in the Judging of Dairy Products. (Courtesy Dairy Industries Supply Association.)

of the data shows that an average of 1.67 body and texture criticisms were made for each sample so criticized. The distribution of these body and texture criticisms is presented in Figure 63.

Of the many possible body and texture criticisms, that of "open" was used in 44, or 28 percent, of the 157 criticisms. "Weak," "mealy," and "pasty" designated the body and tex-

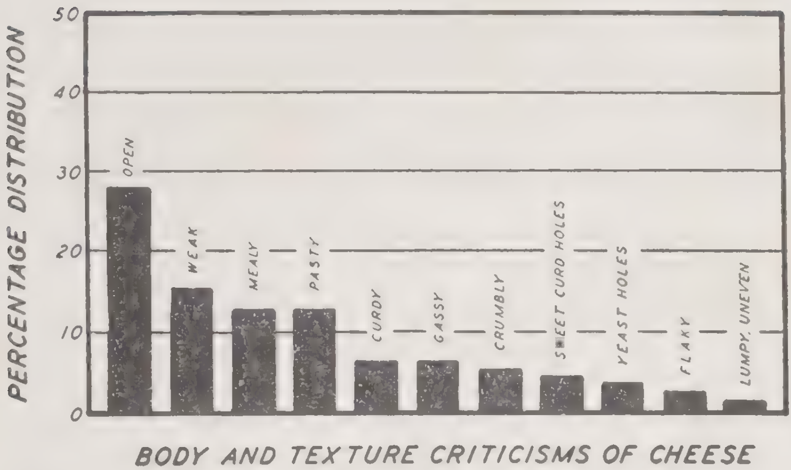


Figure 63 — Distribution of Official Body and Texture Criticisms of Samples of Cheese Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1926 to 1939, Inclusive.

ture defects of 15.9, 12.7, and 12.7 percent of the criticisms, respectively. "Curdy" or "corky" and "gassy" each accounted for 6.4 percent of the criticisms. The remaining 17.9 percent were divided among five other body and texture defects, "crumbly," "sweet curd holes," "yeast holes," "flaky," and "lumpy." A "lumpy" or "uneven" textured cheese was encountered in only one of the 104 cheeses used in official judging.

Combinations of body and texture defects encountered were "open, weak," "open, pasty," "open, mealy," "open, crumbly," "gassy, weak," "gassy, curdy," and "pasty, weak." Occasionally the body and texture was so poor as to merit three or more criticisms. In such cases combinations as "mealy, open (gassy)" or "gassy, open, pasty" or "pasty, open (weak, gassy)" were used.

Guide for Scoring Body and Texture of American Cheddar Cheese

Experience has always been a good guide in evaluating the body and texture defects of cheese. However, getting experience always involves much time. A chart showing the evaluation of the various intensities of the defects is, therefore, helpful. Such a chart, adapted from that proposed by Wilster (1942) is suggested in Table 17. In using this guide, it must be kept in mind that combinations of defects may further lower the score to the minimum.

Table 17 — A Suggested Guide for the Scoring of Body and Texture of Cheddar Cheese

Body and texture defects	Scores allowed when the defect is Slight	Distinct	Pronounced
(Sample not criticized)		29.5 to 30	
(Sample criticized)		26.0 to 29	
Texture defects:			
(1) Fish eyes, yeast holes	28	27	26
(2) Pin holes, gassy	28	27	26
(3) Open, mechanical holes, etc. ..	29	28	27
(4) Swiss, sweet curd holes	29	28	27
Body defects:			
(1) Corky, dry, etc.	29	28	27
(2) Crumbly, friable	28	27	26
(3) Curdy, rubbery	29	28	27
(4) Flaky, short	29	28	27
(5) Grainy, gritty, etc.	28	27	26
(6) Greasy	28	27	26
(7) Mealy, salvy	28	27	26
(8) Pasty, smeary, sticky, etc.	28	27	26
(9) Spongy	28	27	26
(10) Weak, soft	28.5	28	26

Flavor — 45 points

High-quality American cheddar cheese has a characteristic cheddar flavor, described as clean, fine, nutty and pleasantly sweet.

While the same flavor qualities are desired in fresh, in medium cured, and in aged cheese, the intensity of the characteristic cheddar flavor will depend very largely upon the extent of curing and the nature of the curing conditions. Usually, the aged cheese has a sharp, snappy taste entirely lacking in the fresh cheese. High quality cheddar cheese has a flavor appeal like that of a freshly roasted peanut; when either is tasted, the appetite is naturally stimulated for more.

The flavor of cheddar cheese is derived from a blend of (a) the protein which has undergone chemical changes to simpler and more volatile organic compounds; (b) the acid developed in the curd; (c) the butterfat; and (d) the small amount of salt added before the curd is pressed. Due to the high percentage of solids and the nature of the organic constituents, cheddar cheese has a distinct, desirable flavor when the right kind of bacte-

riological and chemical changes have occurred as a result of control in manufacturing and curing.

The beginner should learn early in his judging experience that the finish and appearance, color, and body and texture characteristics will reveal much in regard to the flavor quality of the cheese. He should study carefully not only the desirable qualities of these items, but the undesirable qualities as well, and note the flavor defects that may be associated with them.

After the physical properties of the cheese have been examined carefully, then the flavor may be determined. This is accomplished (a) by noting the odor of the freshly drawn plug as it is passed slowly under the nose; (b) by smelling the warm, semi-soft cheese resulting from the quick kneading of a portion of the plug between the thumb and forefingers; and (c) finally, by tasting a small piece of the cheese. Experienced judges may not taste the cheese at all, but will grade the cheese on the basis of the odor and its association with certain physical qualities. The beginner, however, should taste the sample not only to verify the odors previously noted, but also to get an impression of the non-volatile fundamental tastes — bitter, salt, sour and sweet. Precaution should be exercised in tasting cheese. When a large number of cheeses are being tasted, the mouth should be rinsed out or conditioned between samples in order that any non-liquified portions, which may lodge between the teeth, will not obscure the true flavor of subsequent samples.

A perfect score on flavor of cheese is never given. The range of flavor scores is slightly narrower and higher than that of butter, being from 35 to 42.

Flavor Defects and Their Characteristics

Cheddar cheese off-flavors are generally characterized by their intensity and by their volume. The most common flavor defects found in cheddar cheese are as follows:

1. Acid, high-acid, sour, sour-whey, whey-taint, "green"
2. Barny, cowy, unclean
3. Bitter
4. Chemical, foreign
   a. Disinfectant
   b. Fishy

c. Fly-spray
d. Gasoline
e. Hydrogen sulphide
f. Kerosene
g. Oil
h. Paint

5. Feed
6. Fermented, fruity
7. Flat, insipid, lacking in flavor
8. Heated, cooked
9. Metallic
10. Moldy, musty
11. Rancid, putrid
12. Utensil
13. Weed, obnoxious weed
    a. Garlic
    b. Leeks
    c. Onions
14. Yeasty

1. Acid, high-acid, sour, whey-taint, sour-whey, "green." This flavor defect results from fermentation. As the terms used suggest, the flavor in cheese somewhat resembles that of whey. The flavor is usually very pronounced and may be readily detected by passing the freshly drawn plug under the nose. When a portion is tasted, a "quick" flavor sensation is noted, which soon disappears, leaving the mouth free of any off-flavor sensations. An acid flavor is commonly associated with a dull, faded, acid-cut color.

2. Barny, cowy, unclean. Apparently several terms are used to describe this flavor defect. The off-flavor suggests uncleanliness and may be so mild as to suggest the smell of a cow or of a cow stable, or it may be decidedly unclean as in the case of a "stinker" cheese. The flavor lingers in the mouth long after the sample has been expectorated.

3. Bitter. Although this flavor may be associated with some others which are volatile and, thereby, detectable by the

sense of smell, a bitter flavor is recorded by the sense of taste. Bitter flavors may occur in fresh or in mild cheese, but they are found most frequently in aged cheese. The sharpness and high flavor of aged cheese, however, should not be confused with a bitter flavor. The former gives rise to a temporary peppery sensation, whereas true bitterness is distasteful, resembling quinine. The sensation persists for some time.

4. Chemical, foreign. Many flavors come under this classification. Fortunately, these flavors are encountered infrequently in judging cheese. With the exception of the fishy and hydrogen sulphide, "stinker," flavor which are developed, these flavors get into the cheese through contamination of the milk. Their very nature makes identification of them relatively simple.

5. Feed. Normal feed flavors in cheese are usually masked by other more pronounced flavors which develop following manufacture. These flavors, therefore, are more likely to be noted in fresh cheese than in aged cheese. The flavor often has a clean, aromatic quality.

6. Fermented, fruity. These flavors often suggest the peculiar fruitstore or pineapple odor. The taste is peculiarly sweet and the odor resembles that of fermenting or overripe fruit. Often this flavor defect may be associated with high moisture resulting in a weak, pasty body.

7. Flat, insipid, lacking in flavor. Cheese having this defect is almost devoid of any flavor. The flat flavor is particularly noticeable when the sample is tasted. Likewise, little odor may be detected. Frequently the defect may be associated with a dry, overfirm body.

8. Heated, cooked. The heated, cooked flavor sometimes ascribed to cheese is unlike the clean, distinct cooked flavor of milk, but resembles more the odor of an ill-kept cheese factory on a hot summer day. The flavor is mildly suggestive of uncleanliness in addition to a whey taint. Probably the latter term should be used to describe the flavor sometimes referred to as "heated" or "cooked."

9. Metallic. Metallic flavor in cheddar cheese is rare. The flavor is characterized by its flat, metal-like taste. The sense of smell is of little value in detecting its presence.

10. Moldy, musty. The moldy, musty flavor resembles the odor of a damp, poorly ventilated cellar. The flavor is easily recognized by the smell. The slightly unclean flavor tends to persist after the tasted sample has been expectorated.

11. Rancid, putrid. The rancid flavor is characterized (a) by a slow reaction time; (b) by its prominence after the sample is expectorated; and (c) by its persistence. The flavor is bitter, soapy, very disagreeable and repulsive. In extreme cases the cheese is putrid. Rancidity is caused by the activity of the enzyme lipase, yielding butyric acid. This defect is more likely to be found in aged, or medium cured, rather than in fresh cheese.

12. Utensil. The utensil flavor gives the same sensation as the odor of poorly washed dairy utensils and equipment. It carries the suggestion of the unpleasant odor associated with milk beginning to sour, together with uncleanliness.

13. Weed, obnoxious weed. This flavor defect should be easy to detect as the flavor definitely resembles that of certain weeds, as onions or leeks. The odor of such defective samples is usually mild unless the sample has been held at a relatively high temperature. When the sample is tasted, the flavor is very pronounced.

14. Yeasty. This flavor may be identified by its sour, yeasty taste and slightly fragrant odor. Yeastiness in cheese may be detected very shortly after the sample has been put into the mouth. Since it is caused by yeast growth, occurring most frequently during the summer months, the cheese will likely have yeast holes which may be readily identified.

Distribution of Flavor Defects of Cheese

In 1941, the Committee on the Judging of Dairy Products of the American Dairy Science Association made a study of the official flavor defects of cheese used in the Collegiate Students' International Contest in the Judging of Dairy Products from 1927 to 1938, inclusive. This cheese was scored by recognized judges. The committee pointed out that probably in some cases specific samples exhibiting certain defects were selected for use in the contest and, therefore, the percentage distribution reported might not apply to commercial products as a whole. However, the committee reported that of the 84 samples scored,

59.5 percent of them were criticized for flavor. The prevalence and association of the specific off-flavors were reported as follows:

A study of the data shows that an average of 1.38 flavor criticisms were made per cheese criticized. The distribution of those flavor criticisms is presented in Figure 64. Of the many

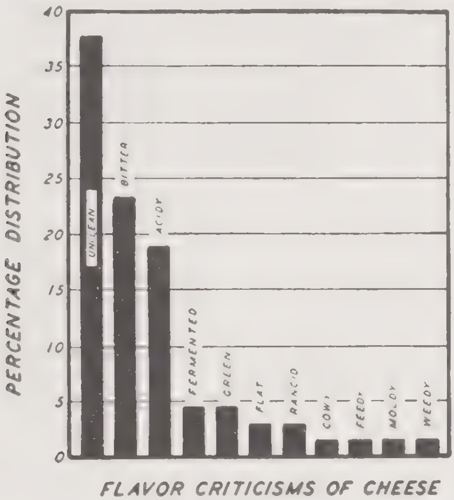


Figure 64 — Distribution of Official Flavor Criticisms of Samples of Cheese Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1927 to 1938, Inclusive.

possible flavor criticisms of cheese, three seemed to command the major attention, namely, "unclean," "bitter" and "acidy," which were present 37.7, 23.2 and 18.8 percent, respectively, a total of 79.7 percent. The remaining 20.3 percent of the flavors was divided among eight other flavors, of which "fermented," "green," "rancid," and "flat" predominated. Such flavors as "moldy," "cowy," "feedy" and "weedy" were encountered but little in the official samples. When only one flavor criticism was made on the sample, the criticism was generally "acidy," "bitter," or "unclean." If two criticisms were made, then "unclean" with either "acidy" or "bitter" was generally used.

Guide for Scoring Cheese on Flavor

The committee on the Judging of Dairy Products of the American Dairy Science Association, 1942, made a study of the evaluation of certain flavor defects having various intensities which might occur in cheese. Some 45 or 50 judges and coaches of dairy products judging teams were asked to nominate five judges whose evaluations of the various intensities might be classified separately. The flavor scores given by this selected panel of cheese judges are tabulated in Table 18, and reclassified

as to the class of cheese in Table 19. While these data are not infallible and are subject to change, it is believed that they furnish a good guide to the evaluation of flavor defects in scoring cheese.

Table 18 — Range and Average Flavor Score of Cheese Designated as Having Certain Intensities of Off-Flavor as Given by Selected Judges

Flavor criticism	Range and average score for cheese flavor when the intensity of the defect was					
	Slight		Distinct		Strong	
	Range	Av.	Range	Av.	Range	Av.
Acidy	38.0–39.5	38.5	37.0–38.5	37.3	35.0–36.5	35.8
Bitter	38.0–39.5	38.5	36.0–38.5	37.2	35.0–36.5	35.6
Cowy	36.0–38.5	37.8	35.0–37.5	36.7	35.0–36.0	35.3
Feed	38.0–39.5	38.7	37.0–38.5	37.6	36.0–37.0	36.5
Fermented .	36.0–38.0	37.3	35.0–37.0	36.2	34.0–35.5	35.0
Flat	39.0–41.0	39.5	38.0–40.0	38.9	37.0–39.0	38.4
Fruity	37.0–39.0	37.8	36.0–38.0	36.7	35.0–37.0	35.5
Heated ...	38.5–39.0	38.9	37.0–38.0	37.8	36.0–38.0	37.0
Moldy	37.0–38.0	37.2	35.0–36.5	35.9	35.0–35.5	35.1
Rancid ...	36.0–37.5	36.8	35.0–36.3	35.7	34.0–35.0	34.8
Unclean ...	37.5–39.0	38.1	36.5–37.0	36.9	35.0–35.5	35.1
Weedy	37.0–39.0	37.9	36.0–37.5	36.8	34.0–36.0	35.3
Yeasty	36.0–38.0	37.1	35.0–37.0	36.0	34.0–36.0	35.0

GRADING CHEDDAR CHEESE

Cheddar cheese can be graded at any age between the time it is removed from the press and the time it is sold for consumption. Experienced cheese graders agree that cheddar cheese from a few days to a few weeks old is more difficult to grade than an older product. In grading a young or "green" cheese the grader must not only pay very close attention to the flavor present but to the flavors that may develop during the ripening period. There are occasions when a cheesemaker, cheese buyer or processor would like to have fresh or "green" cheese graded in order to (a) sell it on a quality basis, (b) determine the use that should be made of the cheese, (c) determine whether the cheese will stand up in storage, or (d) check on the quality of the daily make of cheese.

Different cheese producing areas sometimes grade cheese independent of each other and the grades differ slightly from the federal cheese grade standards. Considering the purposes for

Table 19 — Classification of Off-Flavors of Cheese According to a Suggested Grouping

Suggested flavor classes and score	Flavor criticisms	Intensity of flavor defect	Average score given by selected judges
Excellent (40–45)	....	....	40.0 and above
Good (38.5–39.5)	Flat	Slight	39.5
	Flat	Distinct	38.9
	Heated	Slight	38.9
	Feed	"	38.7
	Acidy	"	38.5
	Bitter	"	38.5
Fair (37–38.5)	Flat	Strong	38.4
	Unclean	Slight	38.1
	Weedy	"	37.9
	Cowy	"	37.8
	Heated	Distinct	37.8
	Fruity	Slight	37.8
	Feed	Distinct	37.6
	Acidy	"	37.3
	Fermented	Slight	37.3
	Bitter	Distinct	37.2
	Moldy	Slight	37.2
	Yeasty	"	37.1
	Heated	Strong	37.0
Poor (36–37)	Unclean	Distinct	36.9
	Rancid	Slight	36.8
	Weedy	Distinct	36.8
	Cowy	"	36.7
	Fruity	"	36.7
	Feed	Strong	36.5
	Fermented	Distinct	36.2
	Yeasty	"	36.0
Bad (35–36)	Moldy	"	35.9
	Acidy	Strong	35.8
	Rancid	Distinct	35.7
	Bitter	Strong	35.6
	Fruity	"	35.5
	Cowy	"	35.3
	Weedy	"	35.3
	Unclean	"	35.2
	Moldy	"	35.1
	Fermented	"	35.0
	Yeasty	"	35.0
	Rancid	"	34.8

which cheese is graded in different areas, the different score cards used and the variations in and over-lapping of standards, it is not surprising that some lack of uniformity exists in the grading of cheddar cheese. On the other hand, remarkable agreement exists in what constitutes top quality or low quality cheese regardless of the area or the grading agency involved.

Some disagreement probably will always occur in grading of "borderline" qualities in the different grades.

Grading of green cheese for storage. Some cheddar cheese is bought and sold when it is "green" or only a few days after it has been removed from the press. Fresh, "green" cheese lacks the cheddar flavor and must be graded on the basis of the kind of a cheddar flavor it will develop during the curing period. There is merit in the grading of fresh cheddar cheese to find out how to utilize it to the best advantage. Some differences of opinion seem to exist as to the value of judging "green" cheese to determine its keeping quality. Due to the fact that certain body and texture and workmanship qualities previously described in this chapter, as well as the flavor qualities, have a bearing on the keeping quality of cheese, it would appear that a qualified cheese grader could determine fairly accurately how a cheese graded when "green" will stand up in storage. In addition to the careful organoleptic examination of a young cheese for storage a history of the manufacturing process including the quality of the milk, whether it was raw or pasteurized, the percentage of culture used and the length of time given each step in the manufacturing process is very helpful to the grader in determining the probable keeping quality of the cheese if it is put into storage.

In the grading of green cheese for industrial uses Price (1943) suggests dividing it into the following classes:

1. *Long Hold* — Quality necessary for most particular use.
2. *Short Hold* — Minor (slightly apparent) defects which will permit short storage without loss in commercial value.
3. *Careful, Immediate Use* — Distinct (easily detected, obvious) defects which require careful sorting according to markets and immediate use of cheese.
4. *Limited Use* — Major (very serious faults) defects which restrict use of cheese to few markets, grinding purposes and immediate consumption.
5. *Culls* — Inedible, not be used for human consumption.

The defects which would necessitate placing cheese in the above classes are as follows:

Defects Permitted in the Different Classes of Cheddar Cheese

Defects permitted	Long hold	Short hold	Careful immediate use	Limited use	Culls
Flavor Defects				All edible cheese which fails to meet the requirements of the three higher grades will fall in this class.	INEDIBLE
Acid	Trace	Slight	Distinct		
Bitter	Trace	Slight	Distinct		
Fermented*	None	Slight	Strong		
Foreign*	None	None	Trace		
Off*	Trace	Slight	Distinct		
Overcured	Trace	Slight	Distinct		
Rancid	None	Trace	Slight		
Salt*	No defect	No defect	Distinct		
Body Defects					
Break*	None	Slight	Distinct		
Firmness*	None	Slight	Distinct		
Roughness	None	Slight	Distinct		
Texture Defects					
Gas holes*	None	None	Gassy		
Swiss holes	None	Too small	Several		
Sweet or shot holes	Few	Several	Many		
Mechanical openings	Close	Medium	Open		
Color Defects					
Acid cut*	None	None	Slight		
Unnatural	None	None	Slight		
Uneven*	None	None	Slight		
Finish Defects					
Huffing	None	None	Slight		
Mold	Slight	Slight	Distinct		
Paraffin*	No defects	No defects	Slight defects		
Rind*	No defects	No defects	No defects		
Workmanship*	No defects	Slight defects	Distinct defects		

*These terms are general groups of similar, related or identical defects. For example, "fermented" flavor might include yeasty, fruity, gassy or whey taint.

In grading cheese the grader should always keep in mind the characteristics of an ideal cheddar cheese in all age classes which Price (1943) summarizes as follows:

"*Flavor* — Pleasing, clean, delicate aroma and, when cured, a nutty flavor.

Body — Firm and springy; when worked between the thumb and fingers, smooth and waxy if cured, curdy if fresh.

Texture — Smooth-boring and close.

Color — Colored or uncolored, uniform, translucent; when fresh, may be slightly seamy.

Finish — Clean, well-dressed, well-shaped, uniform in size, sound rind and mold-free."

Uniformity of grades of cheese graded by different graders. There is generally close agreement among experienced cheese graders on the different grades of cheese. This is especially true in the selection of the high quality and the selection of the low quality grades. If there is a difference of opinion on a grade it is generally on the grades designating the medium quality product. Cheese grading clinics in Wisconsin revealed that experienced cheese graders are not always in perfect agreement in the grading of the in-between grades or border-line grades of cheese. This is not an indication of lack of uniformity in grading as much as it indicates that some graders emphasize some factors and defects more than others.

Comparison of Wisconsin and U. S. grades: The tentative U. S. standards for grades of American cheddar cheese are given in the Appendix and are summarized briefly at the beginning of this chapter.

In the Wisconsin system of grading, three grades are recognized, namely, Wisconsin State Brand, Wisconsin Junior and Undergrade. These grades are described as follows:

Wisconsin State Brand

1. "Flavor. Flavor and taste shall be practically clean, with nothing objectionable. Cheese of this grade must have a flavor clean enough to suit any of our markets, not merely a flavor that will "get by" in certain markets.

2. Body and texture. Cheese must have good body; must be close or medium close but not open. Scattered shot holes are permitted. Must show meatiness and smoothness according to age. Cheese must not be corky, crumbly, mealy, acid, weak, pasty, gassy, or otherwise defective.

3. Color. May be uncolored or of any degree of color recognized in the markets. Must be uniform. Color must not be dull or faded.

4. *Finish and appearance.* Cheese must be well dressed, well shaped, and practically uniform in size. Surfaces must be well closed, sound, smooth, clean, free from checks, and practically free from mold.

5. *Moisture.* Cheese of this grade shall not have more than 38% moisture with an allowance or tolerance not to exceed 1% in excess, so that in no case shall the moisture content of said cheese exceed 39%."

Wisconsin Junior

1. "*Flavor.* Flavor and taste may be slightly defective.

2. *Body and texture.* Body and texture may be slightly defective; may be medium open or slightly gassy.

3. *Color.* May be uncolored or of any degree of color recognized in the markets. May be slightly defective.

4. *Finish and appearance.* May have slight defects in shape and in finish; must be practically uniform in size; surfaces may have slight defects but must be reasonably clean.

5. *Moisture.* Cheese of this grade may have not more than 39% of moisture with an allowance or tolerance not to exceed 1% so that in no case shall the moisture content of said cheese exceed 40%."

Undergrade

"Cheese of inferior quality or finish, having any pronounced inferior or objectionable flavor or taste; which is corky, crumbly, short, mealy, acid, weak, pasty, gassy or otherwise seriously defective, and cheese uneven in color, mottled or too highly colored and faulty in shape, finish and appearance, with surfaces which are defective, and cheese which is inferior to Wisconsin Junior, shall be considered Undergrade."

From the data obtained in the Wisconsin cheese grading clinics (Price, 1943) it appears that the Wisconsin and the Federal standards for cheddar cheese compare about as follows:

> Wisconsin State Brand is as high and possibly a little higher in quality than U. S. A. grade (U. S. No. 1). Wisconsin Junior is equivalent in quality to U. S. grade B (U. S. No. 2) about 80% of the time. Half of the remaining 20% is generally higher in quality than U. S. B grade and the remainder lower than U. S. B grade. Undergrade is lower in quality than U. S. B grade (U. S. No. 2).

FEDERAL GRADING OF CHEDDAR CHEESE

Cheese sold on contract is usually sold on grade with other specifications as to age and package. The cheddar cheese purchased by the United States government for "lend lease" is a good example of a contract sale wherein the cheese is graded according to Federal standards and paid for according to quality as determined by an experienced licensed cheese grader.

In grading cheese to be sold on contract, the grader should become familiar with the specifications set forth in the contract as to package, finish, age and the grade or grades acceptable under the terms of the agreement.

Identification of packages. Before beginning to grade, the judge should insist that all the packages be properly marked. The vat number, the number of the packages in the lot, the date of manufacture, and the kind and style of cheese should be stamped plainly on the end of each box. In addition, the maker's name and the factory number, if the firm has more than one factory, should also appear on the identification. The boxes can be conveniently marked by a stamp that carries all the necessary identification. The number of the vat, the number of packages in the lot, and the number of the factory can be filled in with a number stamp and the date of manufacture can be filled in with a date stamp on a form as indicated in Figure 65.

Cheddar Cheese

Vat No. ....No. of Pkgs. ....

Date of Manufacture ....

Colored Triplets
made by
Consolidated Dairies of Lake County
Ronan, Montana

Factory No. ....

Figure 65 — Identification Which Should Appear on End of Each Box of Cheese

Selection of samples. A box of cheese is selected at random from each vat or lot of cheese which is designated as a "sample." It is customary to inspect a minimum of an average of ten per-

cent of the boxes in each shipment. Consequently one sample is selected from the lots containing 10 boxes or less and two samples for lots containing 11 boxes or more. However, the number of samples selected from each lot is at the discretion of the judge. He determines the number of samples to inspect in each lot, according to the general conditions found in the lots being inspected. Under no condition should any lot be passed without inspecting one sample regardless of the number of boxes contained in it. After the samples are inspected, they are stamped "sample" to identify them. The "samples" are generally handled and stored separately so that the shipment can be conveniently re-inspected after the cheese is stored. Immediately after the shipment is graded the grader sometimes selects a box from a few of the lots and inspects them to compare the quality with that found in the samples of the same lots previously inspected. This is known as "spot checking."

Examining the package. The first step in the grading of cheese is a careful examination of the package to determine if it meets the specifications set forth in the contract or agreement. The kind, quality, and thickness of the wood in the ends, sides, top and bottom of the box and its general condition are carefully noted. The number, size, and placement of nails used to construct the box and, if the contract calls for metal strapping, whether or not the metal straps meet the specifications as to gauge and placement on the box is also determined.

Examining the finish and weighing the sample. After the package has been examined, the cheese is removed from the box and the finish of each cheese carefully examined. The marking on the cheese is compared with that on the box. All the surfaces of each cheese are inspected for bandage, paraffin, and mold defects to see if the finish comes up to specifications. In order to meet standard package specifications, there must be a scale-board on the top and bottom of each cheese and between the cheese where more than one cheese is contained in a box. The cheese is weighed on a scale, which has been previously tested for accuracy, and the net weight compared with that marked on the box.

Determining the grade. The next step is to plug the cheese and examine it carefully for color, body and texture, and flavor. The cheese is plugged from the top about halfway between the

outside and the center. Immediately after the plug has been drawn, about one and one-half inches of the outside end of the plug is replaced. The remainder of the plug is carefully examined as described in this chapter to determine the quality grade to which the lot belongs. In placing the sample in the respective U. S. grade (see Appendix), the specification for each respective grade is carefully followed. Before the cheese is put back into the box, the plugged surface should be sealed with hot paraffin (220° F.—104.4° C.) to avoid mold contamination.

Marking up the grade. As each lot is graded, the lot or sub-lot number, factory number, date of manufacture, vat number, style of cheese and the number of packages in the lot are recorded on the cheese grader's memorandum shown in Figure 66. The weight of the sample is recorded as found. If the cheese weighs up to the net weight or above the net weight marked on the box, the sample is marked "OK" in the column marked "test weight." If the cheese does not weigh up to the marked net weight, the weight shortage is recorded in the "test weight" column. For example, if the box is marked 60¼ pounds and the net weight of the cheese is 60 pounds, then the weight is recorded as ¼ on 1 in the "test weight" column, meaning that one box in the lot was short ¼ of a pound in weight. After the test weight has been recorded, the grade is recorded in the column of the memorandum marked U. S. Grade. If the cheese is graded for the government, each box is usually stamped with a United States Department of Agriculture number or symbol, indicating that the cheese was graded by a federal cheese grader.

Preparing the grading certificate. After the samples are all graded, the "marked weights" of each vat or lot are filled in on the memorandum. The marked weight of each lot is obtained by adding the marked weight on each box in the lot. From the marked weights of each lot the contract weights are determined. If the test weight is marked "OK," then the contract weight is the same as the marked weight. If there is a weight shortage, this short-weight equivalent is deducted from each one of the boxes in the lot. For example, if the test weight is marked one-fourth pound on one box and there are ten boxes in the lot having a total marked weight of 603½ pounds, then the contract weight would be reduced to 601 pounds because 10 boxes with a weight shortage of ¼ of a pound on each box would be equiv-

Form AMA-191

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING ADMINISTRATION

Memorandum No. AMA- 70

Number of pages in this memorandum 1

CHEESE GRADER'S MEMORANDUM

Buyer Dairy Products Marketing Assn. Address Chicago Illinois
Seller Quality Cheese Co. Address Big Bend Montana
Contract No. on which cheese applies C1070 ~~Storage~~ Car No. N.P. 97288
Where graded Gold Medal Dairies Plant (Plant or warehouse) Address Missoula Montana
Date graded March 1, 1945 Graded by J. A. Nelson Grading certificate No. 27098C

Lot or Sub-lot No	Factory No	Date of Manufacture and Vat No	Style of Cheese	Number of Packages	Marked Weight	Test Weight	Contract Weight	U S Grade
24	1636	9-2 No 1	Triplets	10	603¼	¼ on 1	600¾	A
26	"	9-2 " 3	"	12	723	OK	723	A
25	"	9-2 " 2	"	11	665½	OK	665½	A
27	"	9-3 " 1	"	13	782¾	¼ on 1	726¼	B
28	"	9-3 " 2	"	11	602	OK	602	A
29	"	9-3 " 3	"	10	603¼	OK	603¼	AA
34	"	9-5 " 2	"	12	721½	OK	721½	A
35	"	9-5 " 1	"	11	662	OK	662	A
39	"	9-7 " 1	"	12	724	OK	724	A
41	"	9-8 " 2	"	14	843	OK	843	[illegible]
30	1635	10-1 " 1	Cheddars	12	904¼	OK	904¼	A
31	"	10-1 " 2	"	13	977	OK	977	A
32	"	10-1 " 3	"	12	902¾	OK	902¾	A
34	"	10-2 " 3	"	13	978	OK	978	A
35	"	10-2 " 3	"	12	909	¾ on 1	900	AA
33	"	10-2 " 1	"	11	824½	OK	824½	A
36	"	10-3 " 1	"	12	906	OK	906	B
38	"	10-3 " 2	"	11	825½	OK	825½	B
39	"	10-3 " 3	"	13	973½	OK	973½	A
40	"	10-4 " 1	Twins	11	810½	OK	810½	A
42	"	10-4 " 3	"	11	811¼	OK	811¼	B
41	"	10-4 " 2	"	12	884	OK	884	A
40	1634	10-4 " 1	Cheddars	14	1048	OK	1048	A
41	"	10-4 " 2	"	12	904¼	OK	904¼	A
42	"	10-4 " 3	"	13	972½	OK	972½	B
44	"	10-5 " 2	"	12	901¼	OK	901¼	A
45	"	10-5 " 3	"	14	1047	OK	1047	AA
43	"	10-5 " 1	"	14	1052	OK	1052	A
56	"	10-10 " 1	"	12	902	OK	902	AA
				350			24445½	

COPY

Figure 66 — Cheese Grader's Memorandum Which Is Made as Cheese Is Being Graded. (Front.)

alent to a total shortage of 2½ pounds on the entire lot. The total net contract weight of the shipment is obtained by adding all the weights in the contract weight column of the memorandum. The net contract weight is the one used in making the

grading certificate. It represents the number of pounds of cheese for which the vendor will be reimbursed. A sample cheese grading certificate properly prepared is given in Figure 67. The grades of the lots of cheese certified on the certificate were taken from the memorandum which is the grader's official record of the grading.

INSTRUCTIONS TO GRADERS

This cheese grader's memorandum should be issued on the basis of one memorandum for each carload of cheese. The cheese covered by it (and the corresponding grading certificate) should be that called for by the contract which the seller or applicant has with the Federal Surplus Commodities Corporation.

When the grader prepares the certificate, only two copies of this memorandum are necessary. When the grader does not prepare the grading certificate, he should prepare this memorandum in triplicate—the original and one copy to be sent to the office where the grading certificate is prepared and one copy to be retained by the grader. In either case one copy of the memorandum should be attached to the copy of the grading certificate sent to the Washington office.

All lots offered for grading should be entered on the memorandum, but for any lot that is rejected no weights should be entered and the fact that such lot is *rejected* should be indicated under "Grade" in the last column, and the reason should be stated.

Grader's memoranda should be numbered in consecutive order, and the number of pages making up any one memorandum inserted in the proper space.

If purchased on offer-and-acceptance basis, the "Buyer" will be F. S. C. C., Washington, D. C. The "Seller" is the applicant, and his address, contract number and schedule number should be given. If cheese is sold through the Wisconsin Cheese Exchange, the "Buyer" will be Land O'Lakes Creameries, Minneapolis, Minn., and no contract number will be given.

All boxes of cheese meeting grade requirements should be marked with the official grading stamp of the Agricultural Marketing Administration, unless they can be readily identified by a lot or factory number and date and vat number already marked on the boxes.

The grading certificates should be prepared in sets of six—the original (white) and five carbon copies (yellow), of which the—

(*a*) Original, also the second and third carbon copies go to the contractor, who will attach the original and the second carbon to the voucher or invoice covering payment for the cheese and retain the third carbon copy in his files.

(*b*) First carbon copy is to be retained by the grader or in the files of the grading office out of which he operates, or by the grading office that types the certificates.

(*c*) Fourth carbon copy, with copy of memorandum attached, to be forwarded to Roy C. Potts, Agricultural Marketing Administration, U. S. Department of Agriculture, Washington, D. C.

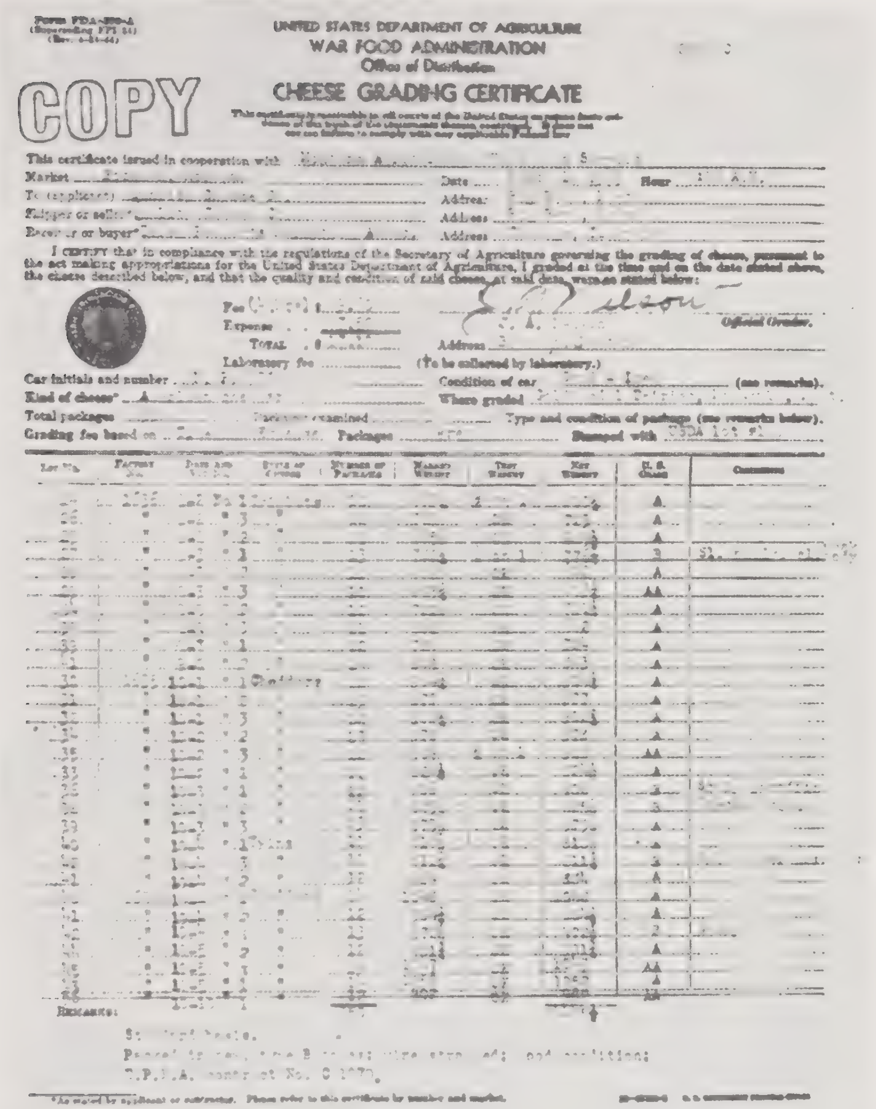
(*d*) Fifth carbon copy is to be sent to the Federal Surplus Commodities Corporation, U. S. Department of Agriculture, Washington, D. C.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1941 O-16—[illegible]

Figure 66a — Cheese Grader's Memorandum. Instructions to Graders. (Back.)

SWISS CHEESE

Swiss cheese, known also as Emmenthal, Emmenthaler, or Schweitzer cheese, is a type of hard cheese made from clean, fresh, whole milk by specific processes of manufacture differing widely from those of cheddar cheese, which result in a cheese of flavor and body and texture characteristics peculiar unto itself. Swiss cheese is characterized by its (a) cream-yellow color; (b) solid, compact, slightly translucent body, which is inter-


UNITED STATES DEPARTMENT OF AGRICULTURE
WAR FOOD ADMINISTRATION
Office of Distribution

COPY

CHEESE GRADING CERTIFICATE

This certificate issued in cooperation with
Market
Date
Hour
To (applicant)
Address
Shipper or seller*
Address
Receiver or buyer*
Address

I CERTIFY that in compliance with the regulations of the Secretary of Agriculture governing the grading of cheese, pursuant to the act making appropriations for the United States Department of Agriculture, I graded at the time and on the date stated above, the cheese described below, and that the quality and condition of said cheese, at said date, were as stated below:

Fee
Expense
TOTAL
Official Grader.
Address
Laboratory fee
(To be collected by laboratory.)
Car initials and number
Condition of car
(see remarks).
Kind of cheese*
Where graded
Total packages
Type and condition of package (see remarks below).
Grading fee based on
Packages
Stamped with

REMARKS:

Figure 67 — Cheese Grading Certificate Which Is Prepared From the Cheese Grader's Memorandum.

spersed with large, shiny surface gas holes that are fairly evenly distributed throughout the center but becoming less numerous near the edge of the cheese; and (c) the peculiarly sweet hazelnut flavor.

Swiss cheese score card. Since Swiss cheese is an entirely different product in many respects from cheddar cheese, the score card used for scoring cheddar cheese is not adapted to the scoring of Swiss cheese. The score card for Swiss cheese recognizes especially the importance of proper hole or eye

development. Two score cards for scoring Swiss cheese are presented. These differ slightly in respect to the emphasis placed upon the holes and upon the flavor; the total for the two items, however, being the same in each case.

Item	Perfect score, as given by	
	Mojonnier and Troy	Sammis; Thom and Fisk
Flavor	40	35
Holes and appearance	25	30
Texture	20	20
Salt	10	10
Style	5	5
Total	100	100

Flavor. A high scoring Swiss cheese should have a clean, distinctive, pleasing, sweet hazelnut flavor. The development of this desirable sweet flavor apparently is associated, to some extent, with the proper "eye" formation. During the process of manufacture and cure, the lactobacilli and propionic acid bacteria play an important role, converting the lactose to lactates and finally to propionic and acetic acid and carbon dioxide. The carbon dioxide, diffused throughout the elastic curd, collects at foci, where it forms individual eyes according to the laws of physical chemistry. Thus the eye formation in Swiss cheese has been believed to be a fairly good indication of typical Swiss cheese flavor. Any condition which interferes with the normal fermentations that develop the typical Swiss cheese "eyes" was thought to jeopardize the flavor of the cured product.

Hammer (1938) having reviewed the literature on the role of propionic acid organisms in Swiss cheese, stated, "The propionic acid organisms are generally considered to influence the flavor of the cheese but certain investigators now believe that they have little to do with eye formation, although at one time they were considered of primary importance in this connection. Cheese that lacks eyes may have a satisfactory flavor, yet cheese that has eyes may also lack flavor, so the relationship between eye formation and flavor production is not a close one."

The flavor defects of Swiss cheese are as follows:

1. Lacking desirable Swiss flavor
2. "Stinker," foul
3. Unclean
4. Unnatural, foreign

1. Lacking desirable Swiss flavor. This defect is characterized by the partial or complete absence of the peculiar, sweet hazelnut, Swiss flavor. The lack of the desired flavor is noticeable when the sample is first taken into the mouth. The defect may or may not be correlated with a lack of, or improper, eye formation. The defect is not as serious as some other flavor defects, although it is not desired.

2. Stinker, foul. A stinker Swiss cheese may be noted readily upon smelling the sample. The odor of hydrogen sulphide or that of spoiled eggs is pronounced. The defect is often localized within the cheese, but may extend over wide sections. This is probably the most serious flavor defect of Swiss cheese.

3. Unclean. Swiss cheese having this flavor defect leaves an undesirable persistent taste after the sample has been expectorated. The defect may be correlated with undesirable eye formation and particularly with a nissler type cheese.

4. Unnatural, foreign. An unnatural Swiss cheese flavor is one which has a clean flavor but one foreign to Swiss cheese. The unnatural flavor may be similar to that of cheddar cheese. The foreign flavor may involve one of the many off-flavors, which can be chemical or bacteriological in origin. The off-flavor may be detected easily.

Swiss eyes. The kind, size, and distribution of the holes or "eyes" in Swiss cheese, in addition to having a possible association with the desirable, typical, Swiss cheese flavor, have a defi-

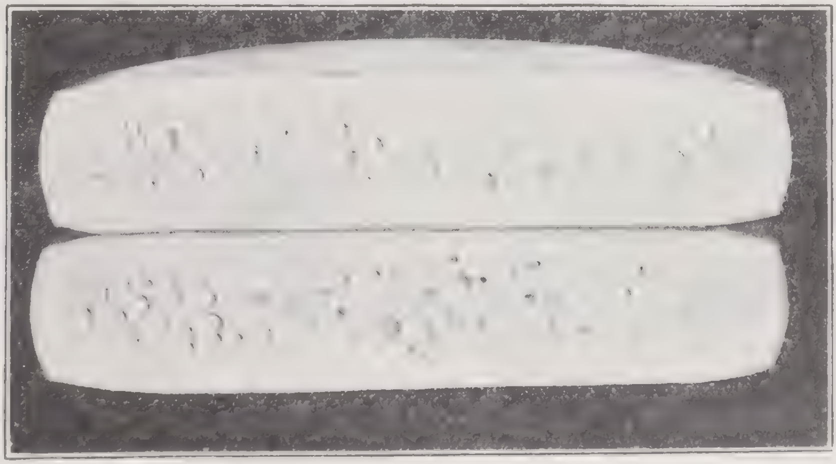


Figure 68 — Cross Section of Swiss Cheese of the Highest Quality. Note the General Uniformity of Size and Distribution of the Swiss "Eyes" and Particularly the Luster of the "Eyes."

nite eye appeal to the consumer (Figure 68). Hence, much emphasis is placed upon this item in judging Swiss cheese. The majority of the eyes should be three-fourths to thirteen-sixteenths of an inch in diameter. The round eyes are preferred in Swiss cheese, but a slightly elliptical or oval shape, not unlike that of an egg, may be accepted without criticism. The distribution of the eyes tends to thin out toward the edge of the cheese, where the cheese is somewhat drier. If the eyes are so large and so numerous as to predominate the plug or slice of cheese, the cheese is to be criticized severely in this respect. The various defects in the eye formation of Swiss cheese are designated as follows:

1. Blind
2. Bloats
3. Dull glossy, shell or dead eye
4. Glaesler, glassler, glass
5. Irregular eyes
6. Nissler, niszler, pin-holey
7. Overset, cabbage, blow holes
8. Pressler
9. Small eyes

1. Blind. A "blind" Swiss cheese is one which has little or no eye formation. The cheese may be solid throughout without any openings whatsoever, or may have a few small eyes scattered here and there. Such a cheese is "partially blind." A blind or partially blind cheese may lack the development of the characteristic Swiss cheese flavor, although blind cheese may be noted occasionally with a well developed Swiss cheese flavor.

2. Bloats. This is a term applied to bloated Swiss cheese. The defect is easily recognized as the cheese will be huffed, in some cases so badly that the sides of the cheese will be rounded as well. In extreme cases the cheese is badly cracked. A plug of such cheese reveals more openings than cheese. The defect is likely the result of yeast growth in a high moisture cheese. The defect may be correlated with a high-acid, yeasty flavor.

3. Dull glossy, shell or dead eye. Swiss eyes lacking a live glossy lustre are designated as dull glossy, shell or dead eye. The defect is easily recognized as the inner lining of the eye

has a dull appearance similar to that of a nut shell. The eyes may be normal in shape and may have a rough lining. The defect is not serious, but is not tolerated in the highest scoring cheese.

4. *Glaesler, glassler, glass.* These terms describe a cheese showing sizeable, parallel clean-cut cracks within the body of the cheese. Apparently a short textured cheese fails to respond to

Figure 69 — Cross Section of a High-grade Swiss Cheese Lacking Somewhat in Uniformity of Size and Distribution of Swiss "Eyes." Note the Dull Appearing "Eyes."

the normal, round eye development characteristic of elastic curd, but splits out sideways resulting in parallel layers of cracks which are not noticed on the surface. The easily detected defect is a serious one in Swiss cheese.

5. *Irregular eyes.* This defect is characterized by distorted, elongated, walnut-shell-shaped eyes. While a medium defect is not serious, the presence of irregular eyes is not desired in the highest quality Swiss cheese (Figure 69). Frequently the defect is associated with oversetting of eyes.

6. *Nissler, niszler, pin-holey.* A cheese which contains numerous small pin holes from the size of a puncture to that of a pin head due to an abnormal gassy fermentation is called a "nissler," which means a cheese with a thousand eyes. A nissler cheese shows practically no Swiss eye development (Figure 70). The flavor of such cheese is usually "off," unclean, and entirely unlike that desired in Swiss cheese. Difficulty is not encountered in recognizing this defect.

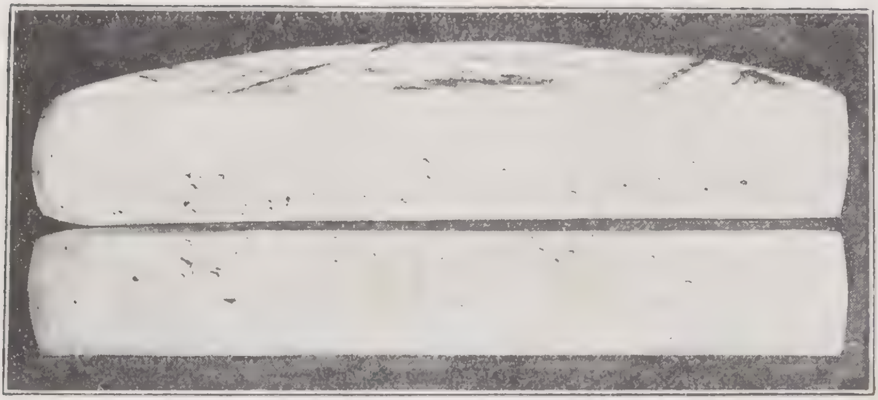


Figure 70 — Cross Section of an Inferior Grade, "Pin-holey," Nissler-type Swiss Cheese.

7. *Overset, cabbage, blow holes.* These terms describe a cheese in which the eyes are so large and so numerous that the cheese between them in some cases is paper thin. A cross section of the cheese often reveals a cabbage-like appearance. The defect is progressively worse toward the center of the cheese. Hence a trier of cheese taken from that section may show a decided lack of cheese substance. The defect may be localized or may extend more or less through the center of the entire cheese.

8. *Pressler.* A pressler cheese is one which develops too many eyes in the early stages of manufacture, particularly while the cheese is still in the press, hence the name. The defect is apparently associated with an undesirable type of fermentation which yields an undesirable flavor.

9. *Small eyes.* While a preponderance of small eyes in Swiss cheese is not desired, their presence does not represent a serious defect. Such a defect refers to cheese having eyes smaller than five-sixteenths of an inch in diameter.

Texture. The texture of high quality Swiss cheese should be firm, meaty, and close, showing flexibility when bent, and be free from "glass," pin holes, sponge or bloats. Occasional picks and checks may be tolerated, provided they are within three-fourths of an inch from the surface. "Picks" are small irregular or ragged openings within the body of the cheese somewhat like small mechanical openings in cheddar cheese. "Checks" are short cracks within the body of the cheese. Due to the low moisture content (31 to 34 percent) the texture is

noticeably firm and, near the rind where the cheese is drier, it is inclined to be slightly crumbly. A soft and pasty texture is likely to be associated with abnormal eye formation of one kind or another and is accompanied with poor flavor.

Salt. Swiss cheese is salted either by floating it in salt brine or by rubbing salt on the outside, or both. Since salt penetrates cheese slowly, difficulty may be encountered in securing uniform salting. The cheese should be lightly salted and uniform in salt throughout.

Finish and appearance. The cheese should be symmetrical, have a smooth, even, closed surface and a clean, dry, sound rind. The ends should be parallel and neither bloated nor sunken. The surface should be free from cracks. The edges should be square, exhibiting no high edges or a cracked open edge known as "frog mouth."

Style. Swiss cheese is made in two general styles — drums or "wheels" about 36 inches in diameter and six to eight inches thick, and a rectangular style about 20 inches long, 8 inches high and 8 inches wide, known as "block" Swiss. Generally Swiss cheese is not made in small styles as the larger styles were thought to be more conducive to the proper eye and flavor development. However, the Iowa Agricultural Experiment Station has developed and marketed successfully a Swiss-type cheese of excellent quality in round, flat styles weighing from 25 to 30 pounds and having a diameter of approximately 16 inches and a thickness of six inches. Even smaller sizes than this have been successfully made and marketed.

Examination of Swiss Cheese

Much can be learned about the quality of Swiss cheese by carefully observing its general appearance. Abnormal internal gas formation will cause the cheese to "bloat" or "huff" and sometimes the cheese will crack due to internal gas pressure and form an opening along the edge known as "frog mouth." A high scoring cheese will not show any of these abnormalities.

The proper number, size and distribution of "Swiss holes" can be determined in a general way by tapping the cheese and carefully observing the sound. The tapping is done by placing the second finger over the back of the index finger and briskly snapping it down on the surface of the cheese. Cheese with a

desirable texture will have a definite sound effect, while a gassy or a blind cheese will respond very differently to tapping. The next step is to plug the cheese and immediately pass the plug under the nose to get the aroma. Carefully observe the size, distribution and appearance of the "eyes." Work a small portion of the plug between the thumb and forefinger and again smell the worked mass of cheese. If the cheese is of high quality it will have a clean, fragrant aroma and a pleasing, distinctly sweet, nut-like taste.

BRICK CHEESE

Brick cheese is a semi-hard, sweet curd cheese made by adding a small amount of culture to fresh uncolored whole milk and curdling it with rennet. Wilson and Price (1935) state that "When it is properly made and cured, brick cheese is softer than cheddar cheese, but is firmer than limburger. It is mild and sweet in flavor and lacks the sharpness of cheddar cheese and the strong flavor of limburger, although possessing something of the flavors which distinguish these well-known varieties."

The score card. The following score card used by the Wisconsin Cheese-makers Association (Thom and Fisk, p. 169) gives the relative importance of the different items considered in scoring brick cheese.

The Brick Cheese Score Card

Flavor	40 points
Body and texture	40 "
Color	10 "
Salt	5 "
Appearance	5 "
Total	100 points

Flavor. Brick cheese should be pronouncedly clean, sweet, mild and have a faint trace of the characteristic limburger cheese flavor. Probably the chief flavor defect of brick cheese is the unclean, off-flavor resulting from abnormal bacterial growth. The defect is readily recognized and is very frequently associated with a gassy texture or split body. Thom and Fisk (1925) believed that one of the worst faults of brick cheese was "bad" flavor due to the cheesemaker not using clean flavored starter

or to the development of too much acid in the curd resulting in a sour flavor. Wilson and Price (1935) stated that some brick cheese is made that contains 42 to 44 percent moisture which has a flavor like limburger, a quality greatly appreciated in some markets. Hanson, Spicer and Price (1938) noted a flat, metallic flavor in brick cheese with which the development of "late-gas" and splitting were associated.

Body and texture. Since the body and texture of brick cheese is equally as important as flavor, this item is given the same number of points on the score card. The body should be firm, smooth, somewhat moist and the texture should be slightly soft and mellow and should break down like cold butter when rubbed between the thumb and forefingers. The texture should not be crumbly, mealy, pasty or sticky. The cheese must have the proper moisture content (37 to 42 percent). If too much moisture is present, the cheese cures too fast and the body will likely be very soft and pasty. If there is not sufficient moisture present the body may be brittle and the texture mealy. Brick cheese usually shows on the cut surface or on the trier several small, irregular, somewhat rounded openings which are not discriminated against. The presence of "shot holes" from the size of BB shot to 3/8 inch in diameter is not very serious. A gassy, pinholey texture is faulted seriously. Sometimes, as shown by Hanson, Spicer and Price (1938) the "late-gas" defect develops causing the cheese to split in the center. This defect is readily apparent when a cross section of the cheese is examined. The defect is associated with swelling or bloating of the cheese which may be noted by casual observation.

Color. Brick cheese may be colored or uncolored, but the color must be clear and uniform throughout. Usually, however, no coloring is added to the milk from which brick cheese is made. Due to the presence of an appreciable quantity of carotenoids in the milk fat of the whole milk throughout most of the year the cured cheese will have a light yellow, slightly translucent color. Sometimes the color is referred to as an egg-shell white. A faded, dull or chalky-white color is discriminated against. Discolored spots or patches are not tolerated.

Salt. Brick cheese usually contains about 1.5 percent salt which may have been applied either by direct rubbing or by floating the young cheese in salt brine. The proper amount of

salt has a marked influence upon the desired ripening of the cheese yielding the typical brick flavor. Salt also aids in the formation of a smooth protective rind on the outside of the cheese. The cheese should have even distribution of the salt throughout. A salty flavor is not desired and interferes with proper ripening.

Appearance. High quality brick cheese has a neat and attractive appearance. Such cheese is clean, well shaped, free from checks and mold and has a well closed rind with a predominantly smooth surface. The cheese is made in one style only, rectangular, in the general shape of a brick, from which it derives its name. The sides should be square, not bulged. A box of several cheeses should show uniformity in size and shape.

Scoring Brick Cheese

As in scoring cheddar and Swiss cheese, the general appearance of brick cheese and its plug will reveal much about its quality. Likewise, a great deal can be told about the quality of the cheese by examining the body and texture.

Press on the surface of the cheese with the fingers. The cheese should have some spring to it, thus indicating a pliable body. Take a trier plug of the cheese and, after getting the aroma at once, note the slightly open texture. The presence of small, irregularly shaped mechanical holes, showing a slight lustre to their surfaces, is regarded as desirable. The cheese should not exhibit gassiness or any developed cracks in the interior which are associated with a slightly excessive acid development.

Work a small portion of the plug between the thumb and forefingers and again observe the aroma of the worked cheese. There should be a large volume of aroma, indicating considerable breakdown of the protein. Taste a portion of the cheese. The sensation should be pleasantly sweet and should enhance the flavor indicated by the aroma. After the cheese is expectorated the flavor should linger for a while but should yield no indication of an "off" flavor.

LIMBURGER CHEESE

Limburger is a semi-soft cheese made from very fresh, whole, uncolored milk of very high quality. No lactic culture is added to the milk before it is coagulated as acid development in the curd is detrimental to the kind of flavor desired in the finished

product. The curd is usually heated only to 95° F. to 100° F. (35° C. to 37.7° C.) and is still soft and shiny when it is dipped into the hoops to drain. Since the curd is not pressed, it retains considerable moisture (40 to 45 percent). The cheese is made into small rectangular blocks about the size of one-half a brick cheese. Salt is applied from the outside. Generally the cheese is rubbed daily during the early days of cure to develop a rind and prevent the growth of mold. The curing room temperature ranges from 58° F. to 64° F. (14.4° C. to 17.7° C.) at a relative humidity of about 95 percent saturation. Due to the low acidity, high moisture and anaerobic conditions for the development of bacteria, the cheese develops a very strong and pronounced characteristic odor and taste suggesting uncleanliness or decay to those not accustomed to it.

The score card. The same score card is used for scoring limburger cheese as is used for scoring brick cheese. The items considered in evaluating its qualities have the same relationship.

Desirable qualities. Limburger cheese should be regular in shape having a smooth rind, free of cracks or breaks. The sides should be parallel, not bulged, and the cheese should not be misshapen. In a cured cheese the color should be uniform throughout and of an egg-shell-white shade, but in an uncured cheese the color may be a little lighter in the center than near the outside. The cheese should contain the proper amount of salt to enable proper flavor development. The body of a cured cheese should be soft, buttery and uniform throughout.

The true limburger flavor should be pronounced without any suggestions of bitter or other off-flavors.

Undesirable qualities. Limburger cheese is subject to most of the defects that are common to other kinds of cheese. Its peculiar flavor is not easy to obtain without a defect, as the low acidity in the curd and the relatively high curing temperature are conducive to the development of the common undesirable bacteria that may gain entrance to the milk by contamination. Gassy cheese caused by gas producing organisms is a common defect which not only gives the cheese a bad flavor but causes it to bloat as well. Too much acid development may result in slow curing, and in a sour, or bitter taste.

Limburger cheese with a dry body will not cure normally and one with a high moisture content results in a rapid curing

cheese with such a weak body and pasty texture that it has a tendency to flatten out during the curing period.

BLUE-VEINED CHEESE

There is a general class of cheese on the market known as blue-veined cheese. The cheese is so called because, in addition to the curd containing lactic acid organisms, it is inoculated with a selected species of blue-green mold, *Penicillium roqueforti,* which upon growth gives it a green streaked or marbled appearance. English Stilton, Italian Gorgonzola, and French Roquefort belong to this class. Cheese very similar to these foregoing types have been developed at some of the agricultural experiment stations in America. These American types are generally called "blue cheese" with the name of the state in which they have been developed prefixed to the name. "Iowa Blue Cheese" is an example.

American blue-veined cheese is made from whole fresh cows' milk to which lactic culture has been added and then coagulated by rennet. When the curd is hooped, *P. roqueforti,* the selected mold, is mixed with the curd or added afterwards through punctures in the cheese. The cheese is ripened at a temperature of 50° F. to 55° F. (10° C. to 12.7° C.) in a room with a very high humidity. The mold grows extensively during the ripening period so that a cut cheese shows extensive openings lined with mold which gives the cured product a green and cream marbled effect. The proteolysis and fat hydrolysis due to the growth of the mold gives the cheese its typical, savory, peppery, piquant flavor.

Scoring the cheese. Although the American blue-veined cheese has increased in popularity and in consumption there never as been a score card devised for it. The authors propose the following score card.

A Score Card for Blue-Veined Cheese

Flavor	45 points
Body and Texture	35 "
Color	15 "
Finish	5 "
Total	100 points

The body and texture is so closely allied with the flavor that it is deemed advisable to allow a high point value for this item. The color of the cheese also has somewhat of a bearing on the flavor as it indicates the general distribution and growth of the mold which is an important factor in the proper ripening of the product. A lack of mold marbling, indicated by a creamy-white or a speckled white color is discriminated against. The finish of the cheese should be neat, uniform, and the outside should be covered with a tight, smooth covering of tin foil or its equivalent to protect the body of the cheese from becoming too dry.

Desirable qualities. A high quality blue cheese has a very distinct, characteristic aroma. The flavor is sharp, peppery and pronounced and lingers for some time after the cheese has been sampled. The lingering flavor leaves a pleasant taste.

The characteristic flavor is due to proteolysis and to the free and combined forms of butyric, caproic, caprylic, and capric acids liberated from the fat by hydrolysis due to the action of the mold. The formation of methyl-n-amyl ketone also contributes to the sharp, peppery flavor.

The body should be moist (38 to 40 percent moisture), slightly sticky, having a tendency to stick to the knife when cut. The texture should be somewhat crumbly with a tendency to crumble when cut. The color should be a marbled cream and green throughout, indicating a good distribution of mold throughout the cheese.

Undesirable qualities. Undesirable qualities are exhibited by dry body and a lack of extensive growth of mold. Without proper mold development, a typical blue-veined cheese flavor cannot be developed. The predominance of the butyric acid odor and a bitter taste are not desired.

Bryant and Hammer studied the defects of blue (roquefort type) cheese and found a black discoloration accompanied by a musty flavor due to the growth of *Hormodendrum olivaceum*. A gray discoloration and a mousy, ammonical flavor, that later became soapy, accompanied by an increase in pH, was also found in some of the cheese by these investigators. The variation from the normal ripening which caused the defect presumably involved the formation of basic products from protein. A phys-

ical defect in which a portion of the edges became soft was also noted.

COTTAGE CHEESE

Cottage cheese is a soft cheese generally made by coagulating raw or pasteurized skimmilk by lactic culture with or without the addition of rennet. The cut or broken coagulum is heated and held for a period of time sufficient to facilitate removal of the whey and to form the curd. When the curd has the proper consistency, the whey is drained after which the curd is washed and salted. Cream may or may not be added. The cheese is consumed while fresh, consequently, the flavor of the product depends on the quality of the skimmilk and the culture from which it is made.

Cottage cheese score cards. Three score cards have been devised for cottage cheese and are given for comparison.

Item	Perfect score as given by		
	Mojonnier and Troy	U.S. Dept. of Agriculture	Washington State College
Flavor	50	50	45
Body and Texture	20	30	25
Composition	20		
Color	5		5
Appearance and Package	5		
Appearance		10	20
Salt		5	
Package		5	5
Total	100	100	100

Flavor. The flavor of cottage cheese is made up of the characteristic flavor of the curd, the acidity in the curd, and of the volatile products formed by the growth of the lactic acid organisms. Cream and salt are added to enrich and to enhance the flavor. Cottage cheese should have a clean, pleasant, slightly acid flavor that cleans up well after the sample has been eliminated from the mouth. The flavor of the curd and the cream should blend well. The percentage of salt added should be just enough to bring out the desirable flavor characteristics of the cheese.

The plain curd is often sold wholesale in bulk for later creaming, packaging and retail distribution. This uncreamed product is known as "dry" cottage cheese.

Its flavor depends entirely on the curd and the products formed in the curd by the culture.

High quality, fresh, clean flavor skimmilk is required to make high scoring cottage cheese. The flavor of the skimmilk and the flavor of the culture must be such that desirable flavor products will be formed in the curd. The cream added must also be of high quality, fresh and have no flavor defects. Flavor defects in the product used to make the cheese will be found in the finished product. The flavor defects of milk, cream and culture have been described elsewhere in this text. The common flavor defects in cottage cheese and the probable causes follow:

Flavor Defect	Probable Cause
Barny	Barny flavor in the skimmilk or in the cream added.
Bitter	Old skimmilk; bitter culture; bitter flavor in the cream added.
Cooked	The added cream heated too high.
Feed	Feed flavor in the skimmilk or in the cream added.
Flat	Insufficient volatile products formed by the culture; flat flavor in the cream added.
Foreign	Foreign flavor in the skimmilk or in the added cream.
High acid	Curd insufficiently washed; developed acidity in the cream added.
Musty	Cottage cheese held too long; mold growth.
Old cream	Lack of freshness of the cream added; holding the creamed cheese too long.
Oxidized	Oxidized flavor in the cream; stored too long.
Rancid	The addition of raw or improperly pasteurized cream.
Salty	Addition of too much salt to the curd.
Sweet	Acidity low; sugar or other sweetener added.
Utensil	Utensil flavor in the skimmilk or in the added cream.
Yeasty	Contamination; stored too long.

Serious flavor defects such as musty, rancid and yeasty cause the cheese to be graded as "no score" as the product will not be accepted by the consumer.

Body and texture. The size of the curd particles and the hardness of the curd in cottage cheese have not been standardized. These qualities are guided largely by consumer preference. However, with the advent of the "pop corn" or sweet-curd type cheese, more emphasis is being placed on large curd particles (Figure 71).

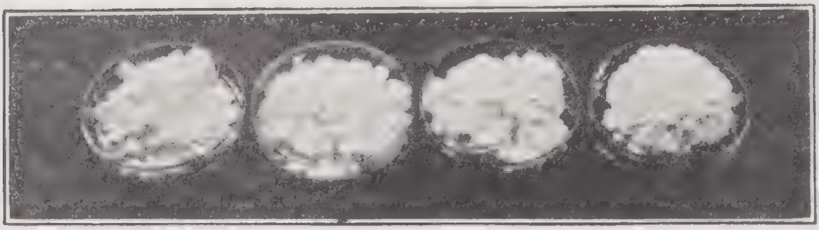


Figure 71 — Cottage Cheese May Range From the Large Curd, Open, Symmetrical Type (Left) to the Closely-packed, Heterogeneous, Small Curd Type (Right).

A desirable body is one that is neither too firm nor too soft. The curd should be sufficiently firm to hold its general shape and yet tender enough not to resist crushing during mastication. A real hard firm curd is called "rubbery" as it resists pressure if squeezed between the thumb and forefinger and shows a slight tendency to spring back when the pressure is released.

A desirable texture is one that is smooth and velvety and has sufficient porosity to absorb readily the added cream.

Lucas (1943) describes the body and texture defects of cottage cheese as follows:

> "Three defects commonly found in body and texture of cottage cheese are mealiness, lumpiness, and a soft, pasty texture. The first is characterized by a sandy, gritty body and is commonly caused by a too low moisture content and by over developing the acid. To prevent it, more moisture may be incorporated by heating the curd more slowly and to a lower cooking temperature. In factories, the degree of acidity should be determined by an acidimeter and cutting should be done when the curd contains 0.55 to 0.6 percent acid. To some extent, curd of this type may be improved by working it well with starter or clabbered milk and by heavy creaming. A tough, rubbery curd in rennet type cheese may be due to the use of too much rennet, too high temperature during cooking, heating at the cooking temperature too long, or insufficient acid in the milk at the time of cutting the curd. Mealiness and graininess are produced by uneven cutting of the curd, lack of uniformity in heating all portions of the curd, undue roughness in agitating the curd which results in breaking up the curd cubes, and by flash pasteurization in many cases.
>
> "Lumpiness is caused by uneven drying and by uneven coagulation of the curd. The latter is caused by variations in temperature throughout the milk during the time it is souring. The use of a double-boiler or jacketed vat helps

overcome this condition. Uneven drying is a common result of draining off the whey in a curd bag. Shifting the curd about during drying to obtain uniform drainage overcomes this condition.

"A soft, pasty texture is due to high moisture content of the curd and is usually controlled when the experience of the maker is such that he is able to judge when a curd has been sufficiently firmed at time of drawing the whey. Setting the milk at a slightly higher temperature and cooking it for a longer time or to a higher degree of heat, removes the chief cause of pastiness. When the curd is broken into fine pieces during the time it is being heated in the whey, drainage becomes very difficult, owing to a clogging of the drain cloth, and a soft pasty texture results. In the rennet types of cheese, pasty body may be prevented by cutting the curd at a lower degree of acidity, by using only skimmilk pasteurized by the holding method, by more thorough expulsion of whey through longer heating, by using less rennet, or by less agitation during the heating of the curd. If the cheese appears sticky, this may be prevented by heating more quickly and using less rennet. Cheese often shows watery spots in the package due to wheying-off. This is caused usually by holding at warm temperatures or by the use of too much rennet."

Appearance. The general appearance of a container of cottage cheese should be attractive and pleasing. The curd particles should be uniform with a smooth coating of cream surrounding them. The cream should be smooth, not foamy, and well absorbed by the curd. The curd should not be shattered and the cream should not show the tendency to flow from the curd as it stands in a sample plate. The appearance of whey is a serious criticism, as it indicates insufficient cooking of the curd or improper draining of the whey in the vat.

Color. Cottage cheese should have a uniform, natural cream color obtained from the blend of the cream and the curd. High or unnatural colors are discriminated against as they definitely indicate the presence of artificial coloring. Concerning the use of artificial coloring in cottage cheese and its associated defects, Lucas (1943) states:

"The Federal definition forbids the use of color. In those states which permit the use of color, the usual amount is about 1 cc. per 1,000 pounds of milk. The coloring matter is diluted in a cup of water and is added after the starter. Addition of the color before the starter may cause white specks in the cheese, especially if the starter used

was over-ripened and unstrained. Old color may cause red specks in the cheese. Uneven color may be caused by addition of color without dilution and by lack of thorough mixing. Too 'high' and too light color are caused by the use of too much or too small amounts of color. The color should be no heavier than that of cream."

Package. Cottage cheese should be packaged in a neat clean attractive container. If the container is metal it should be free from rust. Fibre containers should be well paraffined to make them less absorbent and to lessen the danger of giving the cheese a foreign flavor.

Examination of cottage cheese. Cottage cheese may be examined for odor and taste much in the same manner as other cheese. However, the examination of the body and texture of cottage cheese is somewhat different from that of the hard or semi-hard cheese. After having examined the cheese enmasse for free whey, non-absorbed cream or for curdy cream, wash an ice cream scoopful in a glass of cold water. Allow the curd to settle and then decant the milky water. Repeat the process until free curd is secured. Examine this washed curd for size of the curd particles, for flavor and for texture. If the curd particles of the unwashed cottage cheese appear fairly uniform, the flavor and texture only may need to be examined. In this case washing the cottage cheese under cold running water, retaining the larger particles only, has been found satisfactory for securing curd for detailed examination. An examination of the washed cheese often reveals defects which may have escaped identification in the unwashed cheese.

CREAM CHEESE

Cream cheese is probably best recognized as the soft, white cheese sold in one to four ounce packages wrapped in foil or parchment. Reichert (1936) well describes this cheese as follows:

"Cream cheese is a soft, unripened cheese usually made from cream testing from 12 to 20 percent fat, coagulated by the development of acidity or by the use of rennet, and then pressed in cloth bags. It is creamy white in color, has a fine, smooth texture, and a full, rich cream flavor. The fat content of the cheese varies from 30 to 40 percent, with a corresponding variation in moisture. Neufchatel is a similar cheese made from whole milk and has a correspondingly lower fat content."

Flavor. Cream cheese should have a full, rich, clean cream flavor in accordance with the high percentage of fat present (30 to 45 percent). The low fat cream cheese of the Neufchatel type may have a mild acid taste. Occasionally the mild acid flavor may be noted also in the higher testing cream cheese. Such cheese may not be criticized on flavor, but the sweet, creamy flavor seems to be preferred over the acid flavor. The flavor defects which may be noted in cream cheese from time to time are flat, lacking, sour and yeasty. These may be readily recognized.

Body and texture. Cream cheese should have a soft body yet one sufficiently firm to retain its shape. The texture should be buttery, silky and smooth yielding excellent slicing and spreading properties. Roundy and Price (1941) found that when the cheese was made from cream containing about 16 percent fat, cheese with 50 to 54 percent moisture and 37 to 42 percent fat had the most desirable spreading and slicing properties. They noted that lowering the fat content of the cream from which the cheese was made below 16 percent caused a grainy texture and a crumbly body while increasing the fat content of the cream above 20 percent tended to cause excessive smoothness and stickiness. The body and texture defects of cream cheese may be listed as: coarse, crumbly, excessively smooth, grainy, overfirm, rough, sticky, and too soft. These defects are easily recognized upon examination.

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Review Questions

1. What is cheese?
2. What is whey and what are its chief constituents?
3. What is curd?
4. Name the five factors which in general differentiate the kinds of cheese.
5. Define cheddar cheese.
6. What is meant by the term "cheddaring" as applied to cheddar cheese?
7. What is meant by the terms "green," "medium aged," and "aged" as applied to cheddar cheese?
8. Give the shape, approximate dimensions, and the approximate weight of each of the different styles of cheddar cheese.
9. Why is cheese tempered before it is scored or graded?
10. What is a cheese plug and what is the proper way to obtain it?
11. What are the color requirements of cheddar cheese as observed on the plug?
12. Do defects in color ever indicate other defects in cheddar cheese?
13. Describe a desirable finish for cheddar cheese.
14. Do defects in finish and appearance ever indicate other defects in cheddar cheese?
15. Describe a desirable body and texture for cheddar cheese.

16. Describe a desirable cheddar cheese flavor.
17. Make a chart showing the relationship between the color, finish, body and texture defects in the flavor of cheddar cheese.
18. Outline the grading routine for cheddar cheese.
19. Give three characteristics of Swiss cheese.
20. Describe the characteristic flavor of Swiss cheese.
21. What is the relationship between the "eyes" and the flavor of Swiss cheese?
22. Describe a desirable texture in Swiss cheese.
23. What is brick cheese?
24. Describe a desirable brick cheese flavor.
25. What is limburger cheese?
26. How is the characteristic flavor developed in limburger cheese?
27. How did blue-veined cheese get its name?
28. Name some of the blue-veined cheese?
29. Give some of the qualities of a desirable blue-veined cheese.
30. What is cottage cheese?
31. From what constituents is the flavor of cottage cheese derived?
32. Name the flavor defects in cottage cheese and the probable causes.
33. Describe a desirable body and a desirable texture for cottage cheese.
34. What is cream cheese?
35. List the desirable qualities of cream cheese.

CHAPTER VIII

JUDGING ICE CREAM

The scoring and judging of ice cream is a development of the more recent years. In fact, ice cream is a dairy product which was of little commercial importance even as late as the beginning of the twentieth century. As might be expected, the standards for scoring ice cream are not as uniform and widely accepted as the standards for scoring butter and cheese. Certain qualities of perfection in flavor, body and texture, and package, however, are accepted by judges of dairy products.

In scoring ice cream, the beginner will likely start his work with an eagerness which was not manifest in the judging of the other dairy products. There is usually a pleasant anticipation about ice cream scoring. This enthusiasm is natural and works to the beginner's advantage, resulting in a more intense study and a more thorough knowledge of ice cream, if the eagerness manifested has proper guidance.

When the beginner scores or judges ice cream for the first time, he usually has had very little experience previously in comparing different ice cream samples. The sensations of sweetness and of coldness have been probably the most outstanding characteristics of ice cream. This is an advantage, and not a handicap to the beginner. Obviously, there are no prejudices to break down, and practically all the desirable and undesirable qualities of ice cream will be called to his attention for the first time. Consequently, with good illustrations at hand and with proper teaching, the beginner should soon become a fair critic of the product.

Classification of ice cream. So many different kinds of frozen products are offered for sale to the public that a classification of them seems advisable. Most frozen products are thought of, if not actually called, "ice cream" by the buying public. A classification of "ice cream," in which each frozen product has a definite grouping, has been proposed by Mortensen (1923). A summary of Mortensen's classification of ice cream is presented

in Table 20. Recently Fabian (1939) amplified this classification giving specific descriptions and citing examples for each class of frozen products. The basis of classification of frozen desserts proposed by Fabian is given in Table 21.

Table 20 — Summary of Classification of Ice Cream (Mortensen)

Group	Name	Distinguishing characteristics
1	Plain	Average percentage of fat; plain flavor, e.g., vanilla, caramel, maple.
2	Fruit	Slightly lower percentage of fat, contains fresh or preserved fruits, e.g., strawberry, pineapple, raspberry.
3	Nut	Slightly lower percentage of fat, contains nuts, e.g., walnuts, hazelnuts, pecans.
4	Bisque	Higher percentage of fat; contains a bread product or confection, e.g., macaroons, sponge cake, grapenuts.
5	Parfait	Very high percentage of fat; high sugar. contains egg yolks.
6	Mousse	Very high percentage of fat; contains frozen whipped cream; sugar and flavor.
7	Pudding	Unusually rich, parfait base, with eggs, nuts and fruits.
8	Aufait	Brick ice cream with layers of fruit between the different layers of ice cream.
9	Lacto	Frozen sour skim or whole milk, with sugar, eggs, fruits, and flavoring.
10	Ices	Frozen water, skim or whole milk and sugar, fruits with or without eggs or other solids.
	Sherbet	Frozen water, with milk or skimmilk solids, sugar, stabilizer with or without egg whites, and flavoring; frozen to consistency of ice cream.
	Plain Ice	Frozen water, sugar, stabilizer and flavoring with or without egg whites; frozen to consistency of ice cream.
	Frappe	Frozen water, sugar and natural flavoring served semi-frozen.
	Punch	Ice flavored with liquors, fruit juices or spices, served liquid although partially frozen or ice cold.
	Souffle	Frozen water, whole eggs, sugar and flavoring.

Frozen products judged. Although a great many frozen products are offered for sale throughout the country during the different seasons of the year, most of the sales are made on vanilla, chocolate, strawberry and butter pecan ice cream and on the

Table 21 — Classification of Frozen Ice Cream Products (Fabian)

Group	Name
I	Plain ice cream
II	Nut ice cream
III	Fruit ice cream
IV	Chocolate ice cream
V	Bisque
VI	Candy ice cream
VII	Parfait
VIII	Mousse
IX	Puddings
X	Custards
XI	Ices
XII	Sherbets
XIII	Special forms of frozen desserts
XIV	Sickles

sherbets of various flavors (Table 22). Unless otherwise specified vanilla ice cream is usually the ice cream selected for scoring. The same score card is used for scoring the other ice creams. The technique is identical, the scoring being different only in the standards of perfection for the several flavored products. Within the past few years considerable interest has been manifested in various forms and combinations of the cream and frozen products, such as tarts, pies, cakes, fruit-centered packages, ripples, bars, sickles and other forms. While these are not generally entered in competition and thus scored as such, they are often regularly examined and judged by the enterprising ice cream manufacturer. The ice cream score card may not be especially adapted for this purpose because as will be pointed out later, several items not included in the ice cream score card must be considered.

Table 22 — Distribution of Ice Cream Sales from 221 Plants Representing 51,476,230 Gallons of Ice Cream Sold in 1938[14]

Flavor	Total sales (percent)	Flavor	Total sales (percent)
Vanilla	51.26	Maple	1.07
Chocolate	16.36	Cherry	1.01
Strawberry	7.95	Pineapple	.91
Butter Pecan	3.67	Coffee	.62
Peach	1.46	All other flavors	15.69

The ice cream score card. The ice cream score card which is the basis on which ice cream is judged and which was adopted by the American Dairy Science Association at their annual meeting at Burlington, Vermont, June, 1941, is as follows:

Ice Cream Score Card Used
As Was Approved by
A. D. S. A. at Burlington, Vt., Meeting June, 1941

Item	Points allowed
Flavor	45
Body and texture	30
Bacteria	15*
Melting quality	5
Color and package	5
Total	100

The ice cream score card, like those for butter, cheese, and milk, totals 100 points. In the judging of ice cream as in the scoring of milk, the rating for bacteria must be done in the laboratory, where equipment, laboratory technique, and time are required. Consequently, the ice cream score card, as used, totals less than 100 points. In general practice, however, the item of bacteria is allowed a full rating of 15 points so the total score for ice cream might be comparable with the total scores for butter and for cheese. The beginner should know the entire score card and the value assigned each item in order to conserve time in judging. Furthermore, he should be familiar with the range of scores permitted for the many possible defects.

Ice Cream Scoring

Tempering the samples. The technique of ice cream scoring is markedly different in many respects from the scoring of other dairy products. Since ice cream is a frozen product it must be judged in part in that condition in order to ascertain the body and texture characteristics. Consequently arrangements must be made to hold the sample at a uniformly low temperature so the ice cream retains its physical properties; yet, the temperature maintained must not be so low that the ice cream is intensely cold and unnecessarily hard. When ice cream is too cold, the recovery of the sense of taste from temporary anesthesia, due to the extreme cold, requires a longer period than is expedient for satisfactory and efficient work. Furthermore,

Deductions for bacteria per ml.
*0-20,000 = perfect
20.000-100,000 = deduct ½ point for each 10,000 or fraction above 20,000
100,000-200,000 = deduct 1 point for every 25,000 above 100,000
200,000-50,000 = deduct 2 points for every 50,000 above 200,000

the beginner will have difficulty in determining the true condition of body and texture in the samples if the ice cream is too hard. Generally temperatures from 5° F. to 10° F. (−15° C. to −12.2° C.) are satisfactory for tempering the ice cream for judging. This can best be done by taking the ice cream out of the hardening room and placing it in a dispensing cabinet several hours prior to judging. In this way the ice cream tempers uniformly. Exposing the stored ice cream to room temperatures for tempering purposes is very unsatisfactory as the ice cream melts along the edge of the container while the center remains too hard for dipping (Figure 72). Ice cream in small packages

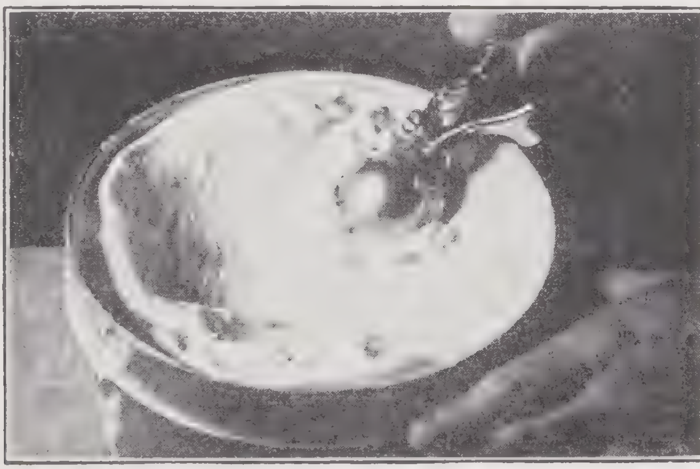

Figure 72 — Ice Cream in Poor Condition for Judging.

and specials may be tempered satisfactorily for judging by grouping them on a table and covering the packages with several clean towels. As a sample is needed for examination, it may be removed, judged and then discarded. The importance of correct tempering of the ice cream cannot be minimized if satisfactory judging is to be attained.

Conditions for best work. Convenience is an adjunct to efficient work. The samples, therefore, should be arranged so they are easily accessible without causing too great an inconvenience in securing a portion for examination. This involves ample spacing of the samples in order to eliminate possible congestion when a number of people are judging. Placing an especially designed dolly under the ice cream tempering cabinets so they may be moved about and arranged at will has been found very satisfactory to provide ample space between samples. The ice

cream is thus easily accessible, well-tempered and conveniently located. The temperature of the room should be comfortably warm. Attempting to judge ice cream in a chilly room usually results in hurried work and hasty judgments. Preferably, the temperature of the room should be too warm rather than too cold.

Sampling. When the ice cream is properly tempered, samples may be taken to show the melting quality and for judging. A regular ice cream dipper or scoop rather than a spoon is preferred in taking samples (Figure 73). Some precautions are

Figure 73 — Kinds of Scoops and Dippers Used in Sampling Ice Cream.

necessary in sampling. If the surface of the ice cream has been exposed, the dried surface layer should be removed before taking a sample for study. The sample for "melt-down" need not be large but must be uniform in size among the various lots of ice cream being judged. For this purpose a No. 30 scoopful of ice cream placed on a clean, numbered petrie dish is satisfactory. The petrie dish should be set in a convenient place where its melting qualities may be observed from time to time during the scoring. The sample for tasting may be secured when it is desired. Individual service or 8- to 10-inch paper

plates have been used satisfactorily for holding the individual samples while tasting. Either one or more samples may be taken on the same plate for study and comparison. Care must be exercised that portions of the samples are not intermixed. Manipulation of and conveying a portion of the sample to the mouth for tasting may be done by means of a compressed paper, fibre, wooden, or clean, bright metal spoon. Some judges prefer the ice cream soda spoons to all others in judging ice cream. A good metal spoon should be part of one's judging equipment. The spoon may be easily cleaned between samples and does not impart any foreign flavor to the product. Compressed paper, fibre, and wooden spoons are satisfactory providing a supply is available so that the used spoons may be discarded at will. In using the wooden spoon precaution must be taken to guard against the slightly woody taste of the spoon when it is first used. Intermittent and unrestricted dipping of the used spoon into the container of ice cream should not be tolerated. Having taken a sizeable sample of ice cream into the individual dish for study, one may taste from this sample as often as desired, securing a sample from the main supply with the appropriate dipper only to replenish that on the individual dish.

Sequence of observations. Since the condition of the ice cream changes so rapidly when exposed to ordinary temperatures, the beginner must be alert and observing during sampling in order not to miss any of the true characteristics of the ice cream, particularly of the body and temperature. Following a certain sequence of observations has been found effective in judging ice cream. When starting to judge the sample, the beginner should note in sequence; *first, the type and condition of the container,* that is, whether it is metal or paper, the presence or absence of a liner and cover and any package defects that may be present. Having noted the condition of the container, the beginner should observe *next the color of the ice cream,* its intensity and uniformity and whether the hue is natural and typical of the flavor of the ice cream being judged. After having made these observations the judge may *then sample the ice cream.* During the actual dipping of the sample, the beginner should note carefully the way the ice cream cuts and the feel of the dipper as its cutting edge passes through the ice cream. He should note particularly whether the ice cream tends to curl

up or roll in serrated layers behind the dipper thus indicating excessive gumminess or stickiness. Especially, should he get the "feel" of dipping; that is, the resistance offered, the evenness of cutting, the presence of spiny ice particles, and whether the ice cream is heavy and soggy, or light and fluffy. The way the ice cream responds to dipping often gives a fairly accurate impression of its body and texture characteristics. The beginning judge, therefore, should be on the alert for indications of possible body and texture defects as the sample is being taken.

After the sample has been secured, the *examination for further body and texture characteristics and for flavor may begin at once.* As a general rule, little conception of the flavor of ice cream may be gained by smelling the sample. Unless the ice cream has been melted and the mix warmed, the ice cream is so cold that for all practical purposes any odoriferous substances present are practically non-volatile and, therefore, little or no aroma may be detected. When the sample is liquefied and warmed to body temperature, the detection of the flavor of the ice cream is not particularly difficult. This is best accomplished by placing a small teaspoonful or bite of the frozen ice cream directly into the mouth, quickly manipulating the sample between the teeth and palate and noting meanwhile the taste and odor sensations.

Since some characteristics of the texture must yet be determined, the ice cream sample placed in the mouth should be in the natural frozen state. Immediately after placing the sample into the mouth, roll a portion of the ice cream between the incisors and bring them together very gently, noting relatively how far apart the teeth are held by the ice crystals and for how long. Note also whether grittiness is apparent between the teeth. A small portion between the incisors may reveal the presence of minute traces of a gritty or sandy texture. By pressing a small portion of the frozen ice cream against the roof of the mouth, thus melting the sample quickly, the smoothness, the coarseness, the coldness and the presence of sandiness and the relative size of the ice crystals may be determined.

When the ice cream is first placed into the mouth, its low temperature temporarily anesthetizes the sense of taste. The sensation of cold is predominant. Until the nerve centers of

taste recover from the temporary anesthesia a flavor sensation is not experienced. The duration of this temporary impairment of taste is dependent upon the size of the sample, the temperature of the ice cream and its heat conductivity. In order not to impair the sense of taste unnecessarily long, as small a sample as necessary to determine accurately the texture should be used.

While manipulating the sample about the mouth to ascertain some of its body and texture characteristics, the beginner must be aware that the ice cream is fast changing its properties, that the period of temporary taste anesthesia is of short duration and that a hint of the flavor of the ice cream will soon manifest itself in a taste sensation. He should be on his guard to detect this sensation, whether it is prompt or otherwise. Probably the first flavor suggested will be one of the fundamental tastes, if present, and in the order of salt, sweet, sour, and bitter. As the sample is warmed in the mouth, any volatile, flavor-contributing substance will soon give rise to a reaction of smell. Since sweetness of ice cream is always noted prior to the volatile, odor-contributing substances, its characteristics should be studied at once. The beginner should notice particularly whether the ice cream is pleasantly sweet, intensely sweet, or lacking in sweetness. Should the ice cream be so sweet that this characteristic is predominant when the product is first placed into the mouth, the beginner should correlate, if possible, that characteristic with a heavy, soggy, wet body.

By the time the quality of sweetness is judged, other flavors will likely have been noted. The beginner should note particularly, whether the flavor is coarse or delicate; mild or pronounced; and whether the flavor is creamy, pleasantly rich or possesses a pronounced, unnatural taste; and whether the mouth "cleans up" after the sample has been expectorated. These are but a few of the many characteristics which must be observed in evaluating the flavor of ice cream.

After the sample has been held in the mouth until warmed to body temperature and its flavor has been noted, it should be expectorated. Occasionally a sample may be swallowed, but this is the exception rather than the rule. When the actual scoring is in progress, the judge's work is that of tasting and observing, not that of satisfying hunger. In ice cream scoring especially, the keenness of taste may soon be destroyed. Some

experienced judges practice eating a little ice cream before the actual scoring begins in order to adjust their tastes to ice cream flavors, but once the judging is underway the samples are expectorated after tasting.

By the time the flavor has been determined, the samples, previously set aside for melting, will have softened sufficiently to yield an accurate picture of **the melting characteristics**. The beginner should observe whether the ice cream has retained its form and approximate size, even though some free liquid may have oozed out; whether the melted liquid is creamy, curdled, foamy or watery; and whether tiny channels are formed as the melted ice cream flows down the side of the mass. Observing the melting cream more closely, he should notice particularly if tiny, glossy beads of cream form first after melting or if the melted liquid flows away as rapidly as it melts. The melting properties should be correlated with the properties of body and texture previously noted and, if possible, with the intensity of sweetness. The study and observations are now complete. The beginner should record his observations on the score card, and assign them the proper evaluations. If the beginner is to make efficient use of his time, and be fairly accurate in his observations, he should follow a certain routine or technique in his scoring somewhat as described.

REQUIREMENTS OF HIGH QUALITY ICE CREAM

Color and Package — 5 points

Color. The color of the ice cream should be attractive, uniform, pleasing and typical of the flavor represented. Vanilla ice cream usually is not colored although in some sections of the country color may be added. As long as the shade of color is a hue of the natural color of butterfat, such as during the June grass season, and neither too pale nor too vivid, criticisms generally are not made of the color of vanilla ice cream. Especially should ice cream other than vanilla have a color in harmony with the flavor used. Color defects in vanilla ice cream may be grouped as follows:

1. Gray, dull
2. Not uniform
3. Too high, vivid
4. Too pale, chalky, lacking
5. Unnatural

1. Gray, dull. A gray, dull, vanilla ice cream is easily recognized by its dead, soiled white, unattractive appearance. Such ice cream suggests uncleanliness in manufacture and, therefore, is one of the more serious color defects. If the gray color is caused by excessive use of flavoring with ground vanilla beans, which may be apparent by the presence of small pepper-like particles of the ground bean, the color should not be criticized. Ice cream showing ground vanilla bean has been in demand in some sections.

2. Not uniform. Lack of uniformity in color in vanilla ice cream is comparatively uncommon, but may be easily recognized. Although the general color may be a desirable creamy white, certain areas may be darker than others. Particularly may this be true on the surface or next to the side of the container where some drying may have occurred. The defect may be associated with old ice cream. If the defect is present only on the surface layer, which should be discarded when judged, the defect is not considered serious. Rarely will streaks or waves be encountered throughout the body of vanilla ice cream.

3. Too high, vivid. A high color in ice cream is objectionable because it is unattractive and connotes artificiality. This defect is very easily recognized. It conveys the idea of cheapness or imitation and of a lack of understanding and care on the part of the manufacturer. Too high color is encountered less frequently each year.

4. Too pale, chalky, lacking. A pale, chalky color is opposite of high color. Such a defect is easily recognized. The defect is not particularly serious, although not as desirable as a creamy white color. The greatest objection to the pale, chalky color is that it connotes low fat in the ice cream.

5. Unnatural. The presence of unnatural color may be recognized at a glance as the color is not in keeping with that of butterfat. An unnatural color may be any shade of yellow not corresponding to the true light-yellow or amber color characteristic of the fat of milk. The common off-shades of color in vanilla ice cream are the lemon-yellows, the very light greenish-yellows, the orange-yellows, and occasionally the reddish-yellows. Where the use of colors in vanilla ice cream is permitted, some manufacturers may select a color to make their vanilla ice cream distinctive in appearance. While the color selected may

accomplish this purpose the ice cream color nevertheless may be faulted by ice cream judges.

Package. The package or container should be clean, neat, attractive, full, and the ice cream covered with clean parchment. Both metal and paper containers should be free of dents, rust, paint, ink smears, battered edges or rough surfaces. A clean, well-spread paper liner is permissible, and even desirable, in an old, metal container. In general the package should reflect neatness and cleanliness throughout, giving one the impression that by the use of a bright, clean container the manufacturer is interested primarily in furnishing the public a high quality product. Some defects in package which may be encountered are as follows:

1. Soiled, rusty, or damaged container.
2. Slack-filled container; ice cream shrunken from container; or ill-shaped retail packages.
3. Lack of parchment on containers; container not covered at the freezer.

The defects in package are so obvious that further discussion is unnecessary.

Package and color are usually rated between 3 and 5 points. Most frequently the samples score perfect in this respect. Deductions for defective color are more common than those for defective package. The manufacturer usually insists on a clean, neat, attractive package. However, as previously mentioned he may wish his cream to possess a shade of color which is distinctly different and one easily recognized by the public. In his endeavor to obtain such a color the natural hue of milk fat is often unintentionally sacrificed.

In the scoring of ice cream for package and color, the beginner should experience no difficulty in recognizing the desirable and the undesirable qualities and giving them the proper deductions, which have a very narrow range, and are based largely upon the intensity of the defect.

Melting Quality — 5 points

High quality ice cream should show little resistance toward melting when a dish is exposed to room temperature. During melting the mix should drain away as rapidly as it melts and form a smooth, uniform, homogeneous liquid in the dish. Any

variations from this behavior cause the attention to be drawn unfavorably to the ice cream and leads the consumer to be suspicious of its quality. Although melting quality merits but five points on the ice cream score card, an improper melt-down is apt to prejudice the ice cream judge so that he may be unduly critical of the other qualities of the product. The normal range of score for melting quality of ice cream is from 4 to 5 points.

The melting quality of ice cream may be observed by placing a scoopful of the sample on a dish and noting its response to melting from time to time as the other qualities of the ice cream are being examined. Although fibre dishes may be used with good success, petrie dishes seem to permit more accurate observation of the melted cream. In setting out the samples and examining them for melt-down, some precautions are necessary, namely:

1. Select a uniformly heated, well lighted area for placing and observing the samples.

2. Place the samples out for melt-down at the beginning of the judging.

3. Avoid dipping some of the samples with a warm dipper and others with a cold dipper.

4. Be sure the sizes of samples set out to melt are fairly uniform in volume.

5. Use a flat bottom dish, not a cup, so the melted ice cream can spread out.

6. Avoid placing the samples near a radiator where they will not melt uniformly.

7. Allow the ice cream to melt naturally.

8. When melting has started, *do not disturb the samples by tilting the containers.*

9. Observe the melting quality at various stages of melting (Figure 74).

The defects in melting quality frequently observed in judging ice cream are as follows:

1. Does not melt, delayed melting, high melting resistance

2. Flaky, scummy, lacks uniformity

3. Foamy, frothy, large air bubbles

Figure 74 — The Melting Appearance of Four Samples of Different Ice Creams After Holding for 0, 20, 40, and 60 Minutes (from top to bottom) at Room Temperature. The Sample on the Left Exhibits Poor Melting Quality.

4. Wheys off, curdled
5. Watery, low melting resistance

1. Does not melt or delayed melting. This defect is easily recognized as the ice cream retains or tends to retain its original shape after it has been exposed to the air temperature of the judging room for some time. Two conditions, namely, formation of a stable jel through use of too much stabilizer and an excessively high overrun are contributing causes to delayed melting of ice cream. In the former case the ice cream retains its shape like a custard even when the temperature is above the freezing point. In the latter case the air cells in the high overrun product act as an insulator thus preventing normal melting. A combination of these two conditions often results in the ice cream showing practically no melting. The presence of this defect in ice cream is very objectionable because it conveys the idea to the consumer that "thickeners" have been excessively used in the ice cream.

2. *Flaky or scummy.* This defect may be noted when the sample is about half melted but is more noticeable when the sample has completely melted. Flakiness is shown by a feathery, light-colored scum on the surface. Sometimes it resembles a fragment of a crust. Usually no indication of wheying-off accompanies the defect. The defect is not particularly objectionable but is not in keeping with the highest quality ice cream.

3. *Foamy or frothy.* A foamy melt may be noted only when the sample is completely melted. Ice cream which shows many small, fine bubbles, upon melting, is not particularly criticized,

Figure 75 — A Sample of Ice Cream Showing Curdiness, Wheying Off, and Resistance to Melting.

but a sample showing a mass of large bubbles one-eighth to three-sixteenths of an inch in diameter is criticized. The melt should be uniform and attractive which is not the case when large air bubbles are present. The consumer associates the presence of foam with excessive overrun even though this defect may not be associated with a high overrun, but with some of the constituents used in the mix.

4. Wheys off or curdled. Wheying-off and curdling are one and the same depending upon the emphasis. One does not exist without the other. A melt showing this defect lacks uniformity and is often very unattractive. The defect may be noted usually by a bluish, watery whey oozing from the melting ice cream at the start of the melt-down (Figure 75). If the sample is disturbed during melting or the observation delayed it may be difficult to see this condition (Figure 76). The ice cream appears chunky, dropping away from the mass in chunks rather

than in creamy droplets. Curdy ice cream is very objectionable as its presence suggests souring to the consumer. Very likely the defect may be attributed to the excessive or incorrect use of enzymic ice cream improvers. Other contributing factors might be associated with acidity, homogenization, or a high calcium and magnesium content.

Figure 76 — A Sample of Ice Cream Showing Curdiness. Judgment on the Melting Quality Should Be Made Before the Ice Cream Reaches This Stage of Melting.

5. *Watery, low melting resistance.* This defect is not particularly objectionable, but is not in keeping with the highest quality ice cream. As the terms suggest, the ice cream melts quickly, the resulting melt being of a thin, watery consistency. The defect is commonly associated with low solids in the mix and may be associated with a coarse, weak body in the ice cream.

Body and Texture — 30 points

Unfortunately, the terms "body" and "texture" are often used indiscriminately and loosely, the two terms being mentioned together in reference either to the one or to the other. *Body* is the property or quality of the ice cream as a whole whereas *texture* is the property or quality of the parts or structure which make up the whole.

Both the body and the texture of the ice cream may be determined readily by the senses of sight and touch The beginner should familiarize himself as early as possible with the various body and texture characteristics of ice cream of which there are many. A high quality ice cream in respect to body and texture should be studied carefully until its qualities are fixed in the mind. *The desired body in ice cream is that which is firm, has*

substance, responds readily to dipping and melts down at ordinary temperatures to a creamy consistency. The desired texture is that which is fine, smooth, velvety and carries the appearance of creaminess throughout. The normal range in score for body and texture of ice cream is 25 to 29.5. Seldom does the body and texture merit a perfect score. A guide for scoring body and texture in ice cream is presented in Table 23.

Table 23 — Guide for Scoring Body and Texture of Ice Cream

Group	Description	Approx. score
Excellent	Firm, smooth, velvety	29.5 to 30.0
Good	Slightly heavy, slightly coarse, slightly crumbly	28.0 to 29.0
Fair	Coarse, crumbly, heavy, fluffy, weak.	26.5 to 27.5
Poor	Buttery, icy, lumpy, sandy.	25.0 to 26.0
Bad	Very sandy, buttery, icy.	24.5 or less

The body defects of ice cream which may be encountered are:

1. Crumbly, brittle, short
2. Heavy, soggy
3. Gummy, pasty, sticky, elastic
4. Shrunken.
5. Weak, watery

The texture defects of ice cream which may be noted are:

1. Buttery, greasy
2. Coarse, grainy, icy, ice pellets
3. Flaky, snowy
4. Fluffy, foamy, spongy
5. Lumpy, gelatin lumps
6. Sandy

Description of Body Defects

1. Crumbly, brittle, short. A brittle, crumbly, short body in ice cream is shown by a tendency of the ice cream to fall apart when it is dipped. The ice cream appears to be dry, open, and sometimes as friable as freshly fallen snow. The particles seem to lack the ability to stick together. When ice cream showing this defect is dipped, there usually remains on the surface of the cream left in the container many loose particles. When crumbly ice cream is placed into the mouth, the sensation of cold is usually not particularly intense. As the ice cream melts, there is a comparatively small amount of liquid resulting. Be-

cause of the inconvenience and loss resulting from dipping crumbly ice cream, a crumbly body is very undesirable.

2. *Heavy, soggy.* A heavy, soggy body ice cream is best described by the terms used. The defect may be noted as the ice cream is dipped. A sample placed in the mouth seems much colder than ice cream of the same temperature but free of this defect due to the greater conductivity of heat from the mouth. The yield of melted ice cream in the mouth is very high. The defect is associated with high solids, probably too much stabilizer, and low overrun. A heavy body is not a particularly serious body defect.

3. *Gummy, sticky, pasty, elastic.* A sticky or gummy body is the exact opposite of crumbly body. Such ice cream seems doughy, putty-like and under certain conditions of temperature and manipulation with a spoon it somewhat resembles taffy

Figure 77 — Sticky Ice Cream.

(Figure 77). The ice cream hangs together, so much so that it has a marked tendency to curl up behind the dipper leaving coarse, deep, irregular waves. Frequently, there may be noted a correlation between a gummy body and a high resistance to melting. Gummy ice cream often fails to melt down or melts down slowly at room temperature. When melting does occur, the shape of the ice cream mass may remain to some extent. The defect is closely associated with the excessive use of stabilizer.

sweeteners, or both. If the defect is associated with the use of excessive percentages of sweeteners, the ice cream may have a very sweet flavor and melt rapidly. The beginner must recognize that all ice cream is sticky to some extent. The ice cream should be severely criticized only when the stickiness is so bad that the ice cream is obviously doughy.

4. *Shrunken.* A shrunken ice cream manifests itself by open spaces between the ice cream and sides of the container. The defect is obvious when the package is first opened for examination. The defect may be associated with low solids, high overrun and unfavorable storage conditions. Since heat shocking may be one of the contributing causes, the judge should be alert to correlate, if possible, this defect with a coarse, icy texture.

5. *Weak, watery.* A weak, watery body in ice cream is usually associated with a low melting resistance, a thin, milky, low viscosity melt and a small proportion of solids when a sample is taken into the mouth. Such ice cream may be compressed easily by slight pressure of the spoon or dipper. The defect may be associated with coarse texture.

Description of Texture Defects

1. *Buttery, greasy.* A buttery, greasy ice cream may be noted by the presence of butter particles in the mouth after the ice cream has been melted or by a greasy coating of the linings of the mouth after the ice cream has been expectorated. The defect is less frequently encountered with each passing year as the importance of adequate homogenization is further appreciated. The beginner should have very little difficulty in recognizing this defect when found. Since the presence of butter particles in a supposedly uniform ice cream is decidedly unappetizing, such ice cream is criticized severely.

2. *Coarse, grainy, icy, spiny.* This defect is perhaps the most common texture defect of ice cream. Such ice cream is characterized by its rough appearance, its structural make-up of comparatively large particles, its feeling of unusual coldness in the mouth, and by its general lack of smooth, velvety character. When such ice cream is placed between the upper and lower incisors there is exhibited a temporary resistance, before the incisors are finally permitted to come together. The beginner should not confuse this resistance with that which is likewise exhibited by a sandy texture. The resistance of the

former is very temporary, almost instantaneous, while that of the latter is of longer duration. Coarse ice cream consists of comparatively large particles of frozen ice cream, in which each frozen particle is so large that the coarseness is obvious. When extreme conditions of coarse, grainy, textures are noted, the ice cream is criticized as being icy. Icy or spiny ice cream is not encountered as often as formerly due to the rapid freezing of a greater percentage of the sugar-water solution at the freezer and to greater protection of the frozen ice cream in cabinets from temperature fluctuations. A pronouncedly icy textured ice cream may be noted during dipping by the feel of the dipper as it strikes or breaks the tiny icicles or spines which have formed. The icy texture may be manifested in two ways; namely, by the presence of layer-like ice crystals or by rounded, shotty-feeling particles of ice. The layer-like crystals are frequently found along the sides of the container, where melting and subsequent freezing has been allowed to occur, while the rounded, shotty-feeling particles are intermixed in the ice cream. Both kinds of ice crystals are objectionable to the trade, as the smooth, even texture desired is lacking. Icy texture is very easy to detect. The ice crystals can be felt easily between the teeth or with the tongue. As the melting of the ice cream occurs in the mouth, the ice particles are left behind temporarily. They register a greater sensation of cold, and as they melt, the flatness of the flavor is apparent.

3. *Flaky, snowy.* A flaky, snowy textured ice cream manifests itself by a tendency to fall apart when dipped. In this respect it has the same characteristic as that noted in a crumbly body. The condition seems to be associated with low solids, low stabilizer and high overrun.

4. *Fluffy, foamy, spongy.* A fluffy ice cream may be noted by the presence of large air cells and an open texture throughout. Such ice cream compresses badly upon dipping and is very objectionable to the retailer who fails to get good dippage per gallon. The defect is closely associated with high overrun. A fluffy ice cream usually melts slowly in the dish, yielding a relatively small proportion of liquid which is often foamy and spongy.

5. *Lumpy, gelatin lumps.* This defect is so uncommon in modern commercial ice cream that a discussion of it hardly seems

worth while. In 25 years of judging ice cream the authors have noted the defect but a very few times. However, a brief description of the defect may have some merit. The presence of gelatin lumps will be noted by the appearance of tiny, deep yellow, semi-translucent particles throughout the ice cream. These gelatin lumps may sometimes be comparatively large. They are easily distinguished from butter particles by their color, and by their reaction to melting. These are especially objectionable to the consumer, because to him it represents contamination and carelessness on the part of the manufacturer. The beginner should experience no difficulty in finding these lumps, if they are present, and recognizing them as such.

6. *Sandy.* A sandy textured ice cream is one of the most objectionable texture defects in ice cream and one of the easiest to detect. Such a texture conveys to the tongue and palate a definite lack of smoothness. When the ice cream melts there remains in the mouth fine, hard, uniform particles suggesting fine sand which are crystals of lactose. The presence of these sand-like particles can be noted in several ways, namely by pressing a thin layer of the ice cream against the roof of the mouth with the tongue to secure quick melting, by bringing the teeth together slowly on a piece of ice cream, or by pressing a small quantity of the ice cream between the thumb and forefinger. Sandy ice cream need not be confused with the coarse, grainy ice cream which results from the presence of comparative-

Figure 78 — A Group of College Students Judging Ice Cream in the Collegiate Students' International Contest in the Judging of Dairy Products. (Courtesy Dairy Industries Supply Association.)

ly large ice crystals. The lactose crystals dissolve more slowly than ice crystals and, therefore, may be noted after the ice cream has fully melted. A high percentage of serum solids, high total solids, age, and heat shocking seem to favor the development of this defect. The ice cream judge should be on guard to detect the presence of associated defects such as might be associated with ice cream stored under unfavorable conditions.

Percentage distribution of body and texture defects. The Committee on Judging of Dairy Products, American Dairy Science Association, in 1941, made a study of the percentage distribution of body and texture defects noted in the ice cream used in the Students' National Contest in the Judging of Dairy Products (Figure 78) from 1926 to 1939 inclusive. While in all probability some specific samples exhibiting certain body and texture defects might have been selected for use in the contests, the percentage distribution of the defects, therefore, might not apply to commercial products as a whole, but it is believed that these figures do give a good indication of the occurrence of body and texture defects in ice cream.

The committee found that during the fourteen year period from 1926 to 1939, inclusive, 77 samples, or 74 percent, of the 104 ice cream samples in the contests were criticized on body and texture. For each sample criticized on body and texture an average of 1.90 criticisms was given. The percentage distribution of these criticisms is presented in Figure 79.

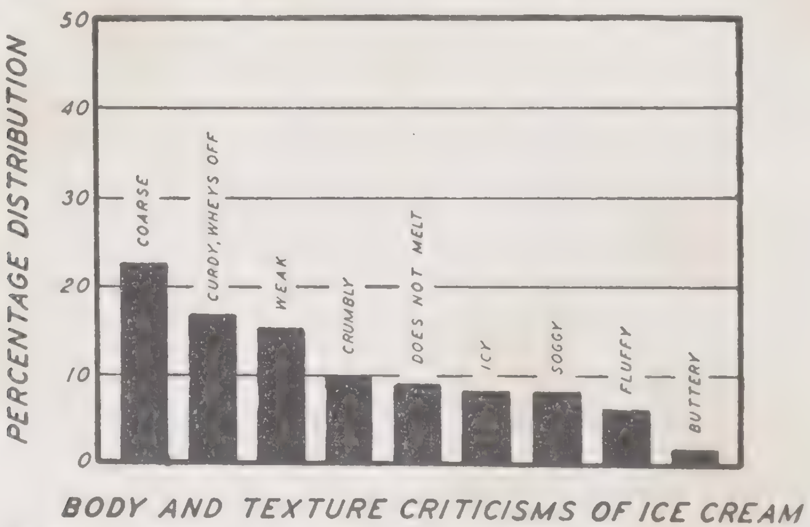

Figure 79 — Distribution of Official Body and Texture Criticisms of Samples of Ice Cream Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1926 to 1939, Inclusive.

The chief body and texture defect of the frozen product was "coarse," being noted in 22.6 percent of the criticisms, whereas "curdy," "wheys off," comprising 18.0 percent of the criticisms, were the chief criticisms of the melted product. Closely following the coarse texture in percentage distribution was the "weak" body with 15.8 percent. The criticisms "crumbly," "does not melt," "icy," "soggy," and "fluffy" were fairly well divided, each being present 9.6, 8.9, 8.2, 8.2 and 6.2 percent, respectively. Three samples, or only 2.1 percent of those criticized were criticized for being "buttery."

Since an average of almost two criticisms per sample was used to criticize the body and texture of the samples, obviously with some samples three or more criticisms were used to describe the defect. The body and texture of one sample was described as "coarse, icy, weak, curdy, does not melt"; another was "buttery, coarse, crumbly, weak, grainy, curdy." However, for the most part such combinations as "coarse, curdy," "coarse, weak," "coarse, crumbly," "icy, weak," "curdy, does not melt," seemed to prevail.

The average body and texture score of 99 samples (five were not included because they were too soft to judge for body and texture) was 22.97; that only of the 77 samples criticized was 22.6; whereas, that of the 22 without criticism was 24.4. Since 1932, when five samples were allowed perfect score on body and texture, no samples have been given a perfect score of 25 on body and texture. Prior to 1931 samples were scored for body and texture as low as 17 or 18. However, since then, the lower limit of body and texture score for ice cream has been established at 20. The mean body and texture score per year for all samples has varied from 23.0 in 1935 to 23.7 in 1939. This does not necessarily indicate a trend toward higher scores for body and texture as the mean score in 1938 was 23.1.

In the above discussion of score for body and texture it should be borne in mind that the scoring was done on the basis of 25, whereas the new score card now allows 30 for this item, not including the five points for melting quality.

Flavor — 45 points

Vanilla ice cream should be pleasantly sweet, having a creamy, delicate "bouquet" vanilla flavor which cleans up well, leaving only a very pleasant aftertaste. Neither the vanilla, the sugar, nor

the dairy products should be so pronounced that when first tasted one is more striking than the others. All the ingredients should blend to yield a pleasant, balanced flavor.

The judging of ice cream flavor offers to the beginner some difficulties unlike those encountered in the scoring of butter, cheese, and milk. As compared to most other dairy products, ice cream is intensely sweet. This sweetness is often so pronounced to the inexperienced judge that it is difficult for him to note other flavors which may be present. The beginner will readily observe the sweetness of ice cream and will judge its comparative intensity with a fair degree of accuracy. However, not all beginners will look beyond this barrier of sweetness to determine other flavors unless they are particularly pronounced. In the scoring of the flavor of ice cream this ability to look beyond the sweetness is very important. With practice, the beginner will soon be able to detect flavors readily without a great deal of interference from the sweetness.

A second obstacle to the judging of ice cream flavor with which the beginner must be aware is the tiring effect of the sweetness on the nerves of taste. Usually the beginner looks forward to the judging of ice cream with considerable enthusiasm. After having tasted a few samples, however, the enthusiasm has waned, the appetite is satisfied and the beginner finds that he must force himself to continue judging although the samples "begin to taste alike." This is the common experience of all ice cream judges. The experienced ice cream judge usually conditions his mouth by tasting several samples of ice cream in order to adapt the nerves of taste to the sweetness before actually placing flavor judgment on any of them. In addition he rinses his mouth with warm water more frequently in judging ice cream than when judging other dairy products.

When scoring ice cream for flavor, tasting is done from a scooped sample. Taste sampling directly from the original container should never be practiced. While the securing of samples of several ice creams on the same plate for tasting is advisable for the experienced judge it is particularly inadvisable for the beginner as the melted ice cream intermixes and thus leads to confusion. Score one sample at a time comparing the flavor with the fixed, mental ideal rather than with that of another sample.

In the scoring of ice cream for flavor, the beginner will not be at a loss for a variety of flavors. Rather, the reverse may be

true; there are so many possible flavors that it will require his best effort to detect and recognize them. Because of the variety of ingredients which may be used in ice cream, it is natural to expect a great variety of flavors in the resulting mix. In general, the ice cream is susceptible to the flavors current in dairy products. The flavoring used may be obtained from several sources and manufactured under different processes. Consequently, the flavoring itself may contribute a variety of flavors. In addition, ice cream possesses the varying degrees of sweetness. The normal range of score for ice cream flavor is from 31 to 40. The major flavor defects of ice cream may be classified according to their origin as follows:

I. Off-flavors from the ingredients used

1. Dairy products

a. Cooked
b. Feed
c. High-acid
d. Old ingredient
e. Rancid
f. Salty

2. Flavoring

a. Coarse, lacks fine flavor
b. Excessive
c. Deficient
d. Unnatural

3. Sweeteners

a. Lacking sweetness
b. Too sweet
c. Unnatural — use of substitute sugars or syrups

4. Other ingredients

a. Egg
b. Stabilizer
c. Other solids than milk solids

II. Off-flavors due to bacterial growth in the mix

1. Cheesy
2. Musty
3. Sour

III. Off-flavors due to chemical change in the mix

1. Flat, metallic
2. Old, stale
3. Oxidized, oily, tallowy

IV. Off-flavors due to other causes

1. Neutralizer, soapy, bitter
2. Foreign

Description of Flavor Defects of Ice Cream

The description of some of the common flavor defects of ice cream which may lead to their identity is presented.

Cooked. The cooked flavor of ice cream often referred to as custard, condensed-milk or dried-milk flavor, is one of the most frequently encountered flavor defects of ice cream. These flavors, although differing in many respects, have much in common. As a group, their presence is not difficult to recognize, but individually it is next to impossible to say with certainty the main source or cause of the off-flavor. The "cooked" milk taste is the characteristic flavor of the group. This flavor is most noticeable immediately after the taste organs have become adapted to the vanilla flavoring. Accordingly, the flavor sensation is somewhat delayed but persists even after the sample has been expectorated. In the earlier days of judging ice cream the presence of a cooked flavor was severely criticized. Recently, however, the presence of a cooked flavor in ice cream is looked upon, not so much as a serious defect, but as a good sign that such ice cream will be stable in flavor so far as becoming stale is concerned, if held a long time or under adverse conditions. Thus, the cooked flavor of ice cream is considered by some as the "sweet flavor of assurance" rather than as a defect. However, it must be borne in mind that if the flavor is so pronounced that particular attention is called to its presence, the ice cream does not have a good flavor blend and, therefore, must be criticized. Even when the flavor is pronounced it is not so serious as to cause the ice cream to be graded as poor or inferior.

Egg. The egg or egg-powder flavor in ice cream is rather hard to describe outside of its own term. The flavor is usually typical of egg yolk but may in addition have a submerged musty flavor. Since egg powder is generally used in ice cream rather sparingly the egg-powder flavor imparted to the ice cream is of comparative low intensity unless the powder used was of poor quality. Egg flavor is not easy to distinguish; it somewhat resembles the cooked or custard flavor, but is even more persistent. Generally, the mouth is very slow in clearing up after such a sample has been expectorated. Although egg flavor is normal to French vanilla ice cream, judges generally agree that its presence in high-quality, plain, vanilla ice cream is not desired as it represents a poor blend and also places a question upon the

quality of this ingredient. Ice cream having this flavor rarely is severely criticized.

Foreign. A foreign flavor in ice cream is easily detected but is often very difficult to identify. The flavor is definitely foreign to dairy products or the ingredients associated with good ice cream, hence the name. Disinfectant, gasoline or paint flavors are examples of foreign flavors. The use of some kinds of substitute sweeteners and milk solids-not-fat in the ice cream mix give rise to foreign off-flavors in the ice cream. As a rule foreign flavors are readily detected because of their pronounced intensity. Ice cream judges are particularly discriminating against them. Such ice cream merits only one of the lower grades.

High-acid, sour. A high-acid and a sour flavor differ chiefly in intensity. This flavor may be distinguished easily from other off-flavors in ice cream by the "quick" taste sensation and its association with the characteristic clean, fresh, acid taste and feel in the mouth. The high-acid flavor may have resulted from the development of lactic acid in one or more of the dairy products used or by holding the ice cream mix at a favorable growth temperature for bacteria for too long a time. High-acid ice cream is discriminated against by all ice cream judges. When the flavor is very high-acid, it is termed sour and as such the ice cream is considered not to be a marketable product.

Metallic, oxidized, oily, papery, tallowy. The oxidized flavor of ice cream may vary so widely in intensity that it requires several terms to describe it adequately. Often this flavor may be encountered only very slightly in which case the ice cream seems *flat* to the taste; a further development of the flavor may be described more accurately as *astringent, metallic* or *puckery*; while other intensities of the off-flavor might be described progressively as *oxidized* or *papery* and in the most intense off-flavors as *oily* or *tallowy*. The off-flavor is one of the easiest to detect in ice cream. Its presence is noted soon after the sample is taken into the mouth and may be noted long after the sample has been expectorated. Such ice cream usually is not repulsive to the taste, but definitely conveys the idea that the ice cream lacks freshness or is old. Ice cream having this defect is discriminated against by all ice cream judges.

Neutralizer. Although neutralizer of any kind should not be used in the manufacture of ice cream, a neutralizer flavor is sometimes noted. When neutralizer is used to reduce the acidity of the ice cream mix, the products formed by chemical reaction in neutralization remain and are often apparent in the frozen product. The beginner should experience little difficulty in recognizing a neutralizer flavor by the peculiar alkali and sometimes slightly bitter taste. The bitter flavor is usually very mild and lacks in intensity as compared to the bitter flavor sometimes noted in rancid milk or butter. The taste reaction time for the neutralizer flavor is somewhat delayed, but the taste persists for some time after the sample has been expectorated. Ice cream having a neutralizer flavor is criticized severely by ice cream judges.

Off-flavoring—Coarse, lacks fine flavor, lacks flavoring, too highly flavored, unnatural. All these flavor defects are associated with the flavoring used. In scoring vanilla ice cream the judge should note first the flavoring, that is, the kind, the amount and the quality if these may be detected, before noting the blend of flavoring with the flavors of the ingredients. In judging ice cream, the judge must keep in mind the desired "bouquet" flavor of high-quality vanilla ice cream. Any deviation from the standard is not desired. The flavoring and the amount used should blend with the other ingredients to yield an appetizing product. Four flavoring defects may be encountered as follows:

1. *Coarse, lacks fine flavor, low quality vanilla.* Such a defect often suggests excessive flavoring which likely is not the case. The taste persists and tends to obscure the true flavor of the dairy products. An ice cream lacking fine flavor is not severely criticized by ice cream judges. However, such ice cream never scores in the excellent class.

2. *Excessive, too high flavor.* This condition is easily recognized when the sample is first taken into the mouth. The flavoring is so striking that the desired pleasant blend of flavor is noticeably lacking. Ice cream too highly flavored is not severely criticized by the judges.

3. *Deficient, lacks flavoring.* Ice cream with this defect is often criticized as flat. While the ice cream may be pleasantly sweet and free from any dairy product off-flavor it lacks the

flavor appeal characteristic of excellent vanilla ice cream which has a delicate "bouquet" flavor. Ice cream lacking in flavor is never placed in the excellent class by ice cream judges.

4. Unnatural. Some practice may be needed in judging ice cream to recognize unnatural vanilla flavoring, and to distinguish between the two major types commonly found. The beginner, however, will have no difficulty in detecting that the flavoring is unlike that desired. Generally, the presence of unnatural flavoring gives the sensation of too high flavoring. Unnatural flavoring may be of the coumarin or "newly-mown-sweet-clover," aromatic type or of the synthetic vanillin or "medicinal" type. Coumarin yields a relatively slow reaction time giving a rather pleasant taste sensation sometimes described as a "vanilla-wafer" flavor. On the other hand, synthetic vanillin produces a "quick," sharp, burning sensation on the sides of the tongue giving rise to a strikingly persistent "medicinal" taste. Once these flavors are recognized as such the beginner should have little difficulty in identifying them when encountered. The use of vanilla compounds, that is, natural vanilla fortified with coumarin, heliotropine, tonka beans, synthetic vanillin, or to purely imitation vanilla preparations may give rise to unnatural vanilla flavors in ice cream between the two extremes described.

Other unnatural flavors may be encountered in judging ice cream which may be due to the use of extracts other than vanilla. While they may be suggestive of spices, marshmallows, custards, candy, almonds or maple, the ice cream judge usually classifies them as unnatural. Unnatural flavor ice cream is usually rated in the fair group by ice cream judges.

Off-sweetening — Lacks sweetness, too sweet, unnatural sweetness. An ice cream lacking in sweetness or too sweet is noted readily upon tasting, the former tending to give a flat taste whereas the latter may exhibit a candy sweetness. In either instance the desired blend of flavor is noticeably lacking. Ice cream with only these flavor defects is not severely criticized. On the other hand, if the sweetener used results in a definite off-flavor which may be entirely foreign to the ice cream then the ice cream will likely be placed in the poor or fair group. Off-flavors due to the sweetener used may sometimes resemble honey, malt, molasses or even high-acid and musty. Regardless of

the source of the off-flavor, the defect should be specifically described, if possible.

Old ingredient, old, stale, musty. The presence of this flavor defect in ice cream may be noted toward the end of the tasting period. Its taste reaction time is relatively slow as is also its adaptation time. Consequently, the defect is not noted when the sample is first placed into the mouth but persists for some time after it is first perceived. Usually the beginning judge has difficulty distinguishing between this class of off-flavors and that of the so-called oxidized flavors. While the chemical changes resulting in these defects may be closely related, the old-ingredient flavors more often give a slow reaction time, are not pronounced, and are suggestive of uncleanliness, whereas, the oxidized flavors yield a comparatively quick taste reaction, are pronounced, and have no suggestion of uncleanliness. Pronounced old ingredient flavors are sometimes somewhat repulsive. Ice cream having these off-flavors is invariably graded into the poorer class by ice cream judges.

Rancid. Rancid ice cream is encountered less frequently each year. The specific delayed reaction time characteristic of rancidity with its attendant, persistent repulsiveness is characteristic also in rancid ice cream. However, the sweeteners and flavoring mask the true rancidity so that, unless the defect is very pronounced, the off-flavor may not be recognized as such. The blend of flavors gives the sensation of uncleanliness. Rancid ice cream is severely criticized by ice cream judges.

Salty. A salty flavor in vanilla ice cream is encountered less frequently each year. The flavor may be readily detected as the reaction time is very short, giving rise to what is sometimes referred to as a quick flavor. A salty flavor may be associated sometimes with a high percentage of milk solids-not-fat. Unless the defect is particularly pronounced the ice cream is not severely criticized.

Suggested Guide in Scoring Ice Cream for Flavor

The Committee on the Judging of Dairy Products, American Dairy Science Association, 1942, made an evaluation study of the various flavor defects of ice cream. Five nationally recognized authorities on ice cream were asked to place independently an evaluation on certain ice cream flavor defects of various inten-

Table 24 — Classification of Flavors of Ice Cream According to a Suggested Grouping

Suggested grouping for off-flavors	Flavor criticism	Intensity of flavor defect	Average score given by selected judges
Excellent (40–45)	. . . .	. . . . . .	40 and above
Good (39.5–37.5)	Lacks fine flavor	Slight	39.4
	Lacks flavoring	"	39.4
	Lacks freshness	"	39.2
	Lacks sweetness	"	39.2
	Cooked	"	39.1
	Egg	"	38.9
	Lacks fine flavor	Distinct	38.7
	Lacks flavoring	"	38.4
	Lacks freshness	"	38.2
	Lacks fine flavor	Strong	38.1
	Storage	Slight	37.9
	Egg	Distinct	37.8
	Lacks sweetness	"	37.8
	Salty	Slight	37.7
Fair (37.5–35.5)	Cooked	Distinct	37.5
	Feed	Slight	37.5
	Lacks flavoring	Strong	37.5
	Unnatural flavoring	Slight	37.3
	Lacks freshness	Strong	37.3
	Old ingredient	Slight	37.1
	Oxidized	"	36.8
	Egg	Strong	36.6
	Metallic	Slight	36.6
	High acid	"	36.1
	Lacks sweetness	Strong	36.0
	Storage	Distinct	35.8
	Unnatural flavoring	"	35.8
	Feed	"	35.7
Poor (35.5–31.0)	Neutralizer	Slight	35.4
	Salty	Distinct	35.4
	Rancid	Slight	35.3
	Unclean	"	35.3
	Old ingredient	Distinct	35.2
	Cooked	Strong	35.1
	Metallic	Distinct	34.6
	Oxidized	Distinct	34.6
	Unnatural flavoring	Strong	34.3
	High acid	Distinct	33.8
	Feed	Strong	33.6
	Neutralizer	Distinct	33.6
	Unclean	"	33.6
	Storage	Strong	33.3
	Rancid	Distinct	33.2
	Old ingredient	Strong	32.7
	Metallic	"	32.6
	High acid	"	32.4
	Salty	"	32.4
	Neutralizer	"	31.8
	Oxidized	"	31.8
	Unclean	"	31.2
	Rancid	"	31.0

sities. These data are compiled in Table 24. It is believed that with some minor exceptions these data furnish the best guide available in evaluating flavor defects of ice cream. Certainly, the material is of incomparable value to those interested in becoming more proficient ice cream judges; in unifying and standardizing ice cream judging throughout the United States, and in furnishing a common basis for recording and evaluating research in which ice cream flavor data are involved.

Percentage distribution of flavor defects in vanilla ice cream. The Committee on the Judging of Dairy Products, American Dairy Science Association, 1940, made a study of the distribution of off-flavors in ice cream used in the Collegiate Students' International Contest in the Judging of Dairy Products from 1927 to 1938 inclusive. It was pointed out that in many cases, specific flavor samples were selected for use in the contest and, therefore, the percentage distributions reported might not apply to commercial products as a whole. However, the data should give a good indication of the type of off-flavor which will be encountered most likely in ice cream. The report in part, follows:

"During the twelve year period from 1927 to 1938 inclusive. 80.95 percent of the official ice cream samples in the contests were criticized on flavor. For each sample criticized on flavor an average of 2.04 criticisms were given. The percentage distribution of the flavor criticisms of ice cream during this period are shown in Figure 80.

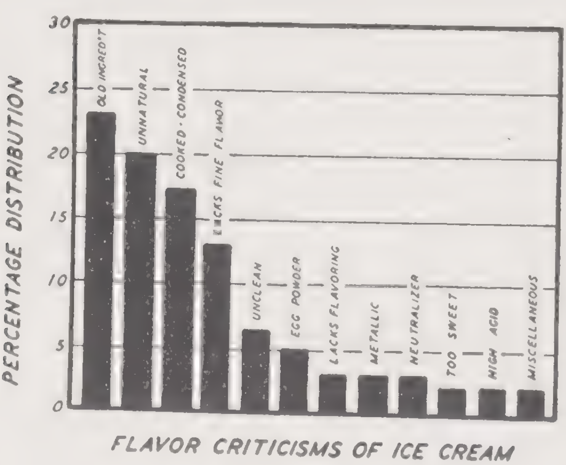

Figure 80 — Distribution of Official Flavor Criticisms of Samples of Ice Cream Judged in the Collegiate Students' International Contest in the Judging of Dairy Products, 1927 to 1938, Inclusive.

"Four flavors, 'old ingredients,' 'unnatural,' 'condensed or cooked,' and 'lacks fine flavor,' were noted in 23.02, 20.14, 17.26 and 12.95 percent of the samples, respectively, a total of 73.37

percent. 'Unclean' and 'egg powder' ranked next in percentage incidence with 6.27 and 5.03 percent, respectively. The remaining 15.13 percent was about equally divided among 'lacks flavoring,' 'metallic,' 'neutralizer,' 'too sweet,' 'high acid,' and 'miscellaneous' being 2.87, 2.87, 2.87, 2.15, 2.15 and 2.15 percent respectively.

"Combinations of flavor criticisms were very frequent, as shown by the fact that when a criticizable flavor was noted an average of two criticisms was given to describe it. Combinations which seemed to recur most frequently were 'old ingredient,' and 'unnatural' or 'lacks fine flavor' and 'unnatural' or 'lacks fine flavor' and 'unnatural.' Occasionally, another flavor criticism, 'unclean' or 'cooked,' 'condensed,' or 'dry milk' was used also with the combinations of the two previously mentioned."

MAJOR DEFECTS IN ICE CREAM OTHER THAN VANILLA

Chocolate

Flavor. Some of the flavor defects associated with vanilla ice cream may be associated also with chocolate ice cream. Particularly is this true relative to sweetening. On the other hand it must be borne in mind that a good chocolate flavor is so pronounced as compared to vanilla ice cream that many of the off-flavors attributable to the dairy products in vanilla ice cream are masked by the chocolate. However, in judging chocolate ice cream the judge soon is aware of certain flavor defects which seem to be more or less specific to that flavor. These defects may be grouped as follows:

1. *Lack of true chocolate flavor.* This defect may be encountered rather frequently and may be noted in chocolate which from the standpoint of color might appear to be all that would be desired in ice cream. If a blindfold test were made on chocolate ice cream having this defect it is highly questionable whether or not the ice cream would be designated as chocolate. This lack of true chocolate flavor may have been due to the chocolate constituent itself or to the excessive use of flavor carrying sweeteners in the chocolate ice cream mix such as honey, malt syrup or molasses.

2. *Lack of uniformity of chocolate flavor.* Although some ice cream manufacturers desire a special type of chocolate flavor,

bitter, for example, there seems to exist a lack of uniformity of chocolate flavor within the type. In judging classes of chocolate ice cream samples secured from several manufacturers this lack of uniformity of chocolate flavor is often particularly striking. This defect of chocolate ice cream applies particularly to a group of samples rather than to individual samples.

3. Unnatural, chocolate flavor. While this term might possibly describe the ice cream lacking a true chocolate flavor, it is applied to those off-flavored chocolate ice creams having a definite cinnamon, fudge, jam or vanillin taste. While cinnamon and vanilla may be used to produce a desirable blend of chocolate flavor they should never be used in proportions causing the non-chocolate flavor to be pronounced. An unnatural chocolate flavor is perhaps the most serious flavor defect of chocolate ice cream which pertains particularly to the flavoring material used.

4. Bitter. Some manufacturers prefer a bitter chocolate ice cream. Yet in the manufacture of this ice cream provision may not be made for a slight necessary increase in the percentage sugar to overcome some of the bitterness, consequently, the bitter flavor results. Burke (1933) stated, "The majority of chocolate ice cream is ruined as a result of using too much cocoa or chocolate flavor and then attempting to mask the resulting bitter or strong taste with an overdose of sugar. The result is a mix that shows poor whipping qualities and an ice cream that melts quickly on exposure to room temperature." This flavor is not considered a defect unless sufficiently pronounced as to border on the disagreeable. The defect is considered as being less serious than an unnatural chocolate flavor. Consumers in some localities like the bitter-sweet chocolate in preference to the mild, benign flavored chocolate.

5. Poor blend of flavor. This defect of chocolate ice cream is very common due probably to the fact that the chocolate flavor often is pronouncedly striking thus detracting from the sensations of sweetness and richness which are secondary. The defect is not a serious one.

Body and texture. The body and texture of chocolate ice cream may be slightly different from that of vanilla ice cream, especially when a separate chocolate mix is prepared. In such a mix a higher sugar content would influence to some extent the

resulting body of the ice cream. Chocolate ice cream will likely contain from 2 to 5 percent of cocoa or chocolate liquor. Difficulty is often encountered in whipping chocolate ice cream mixes. Consequently, a lower overrun and a heavier body may result.

Since the chocolate ice cream may contain a higher percentage of sugar than vanilla ice cream a faster melt-down may be expected. Other melting qualities of chocolate ice cream may occur as in vanilla ice cream.

The texture of chocolate ice cream may be somewhat smoother than that of vanilla ice cream due possibly to the increased sugar and added cocoa fat. A crumbly, short texture is encountered frequently in chocolate ice cream especially when it is examined at too low a temperature.

Color. The color of chocolate ice cream is subject to several defects:

1. Too light. Such chocolate ice cream lacks appeal. Sometimes the defect is so pronounced as to merit the designation "white livered." This defect is very striking when the samples from several manufacturers are compared.

2. Too dark. Sometimes the ice cream is so dark as to appear on the black order. The ice cream does not have the chocolate hue. If such ice cream carried a pronounced chocolate flavor the defect would not seem too serious, but often there appears to be little correlation between the color and the intensity of the chocolate flavor.

3. Greenish-black discoloration. This defect in chocolate ice cream may be noted next to the metal can or to the metal sometimes used in parts of the individual package. The defect is localized, rarely extending into the bulk of the ice cream for any appreciable distance. Dahlberg (1923) found this greenish-black discoloration to be due to chemical reaction between the tannins in cocoa or chocolate and exposed iron or rust spots on the containers. While the defect is very infrequently encountered, nevertheless it is considered as a serious defect when it does occur.

Strawberry Ice Cream

Flavor. The flavor of strawberry ice cream is subject to certain defects which are almost specific to that particular prod-

uct. Therefore, in judging strawberry ice cream the beginner should be aware especially of the possibilities of these defects as well as of those which might be attributable to the basic dairy products used. These defects may be described as follows:

1. Oxidized. Of the various fruit ice creams, strawberry ice cream is especially susceptible to the development of the old, metallic, stale, oxidized, tallowy flavor. Little difficulty is encountered in detecting and recognizing this defect. Usually the off-flavor is far more pronounced than the same flavor in vanilla ice cream. Much data has been assembled on the causes of the oxidized flavor in strawberry ice cream. These data are too extensive to review here. It may be stated however, that the presence of copper in some of the materials used, largely through handling in copper equipment is the chief cause of the defect. Usually the flavor defect is accompanied by a decidedly bleached color which may be readily recognized.

2. Artificial.. An artificial or unnatural flavor in strawberry ice cream may be encountered occasionally when judging several samples of strawberry ice cream from several plants. The ice cream lacks the true fruit flavor of fresh strawberry ice cream. Sometimes the artificial flavor is so pronounced that it seems almost medicinal in character.

3. Stale-fruit. A stale-fruit flavor in strawberry ice cream is sometimes encountered. This defect is not too easily recognized as such although the flavor is definitely not that which is desired. The ice cream may lack freshness, may be very slightly musty or may be definitely old. However, the defect has no semblance of the oxidized flavor. The stale-fruit flavor can be substantiated by segregating some of the fruit pulp and tasting it separately and possibly checking its flavor with the flavor of the fruit used.

Body and texture. While strawberry ice cream is subject to many of the body and texture defects which may occur in vanilla ice cream, the specific body and texture defects of strawberry ice cream are very limited. These are associated chiefly with the fruit and with possibly the higher sugar content resulting from the added berries. In judging the body and texture of strawberry ice cream particular attention should be paid to the amount of fruit present and to its distribution. Often the ice cream may be criticized as *lacking* or *unevenly distributed* fruit.

Color. The color of strawberry ice cream is subject to several defects as follows:

1. Unnatural. An unnatural strawberry color is particularly noticeable when several samples of strawberry ice cream from different manufacturers are judged. An unnatural strawberry color lacks the desired hue of a strawberry color. Frequently an orange or yellowish hue may be noted. This defect is not particularly serious but is not in keeping with the desired color of strawberry ice cream.

2. Too light or too deep color. Often the hue of strawberry color is satisfactory but its intensity is off. More frequently the strawberry ice cream may be criticized for being too light in color rather than for being too high in color. The defect is not serious unless the ice cream is noticeably lacking in appeal.

3. Bleached or faded. This color defect of strawberry ice cream is perhaps the most serious of the color defects of strawberry ice cream. The defect may be readily recognized by its light, off-hue, dead color, which may be closely associated with the oxidized flavor. Such ice cream has little eye appeal.

4. Blue surface. This defect is very uncommon, but the authors have encountered such a defect in grading commercial ice cream in a plant experiencing a break in the ammonia lines thus saturating the storage rooms with ammonia. Strawberry ice cream showing this defect was as blue on the areas of the surface affected as blueberries. The defect was as extensive as the gas was able to penetrate, but was not deep. This defect is mentioned only to call attention to its possibility should such conditions be encountered.

Other Ice Creams

In judging ice cream other than the vanilla, chocolate and strawberry ice cream previously discussed in detail, the judge should be aware of possible defects associated with the particular ice cream being judged. For example, in judging nut ice creams the judge should be alert to the possibility of sandiness and stale nut meats, and in judging fruit ice creams to the blend of flavor and color and to the even distribution of the fruit.

Examination of Packages and Specials

The examination of packages and special ice creams should not be overlooked. Frequently these have defects which are not present in the bulk ice cream made by the same manufacturer.

Packages. Packaged ice cream should be examined for weight, shrinkage, ice crystals, and fruit distribution as well as for the other items on the ice cream score card. After the weight and shrinkage have been determined, cut the package into sections noting the fruit distribution.

Coated Bars. In judging ice cream bars the coating should be examined as well as the ice cream. Frequently this method of examination will reveal the presence of a flavor defect formerly attributed to the ice cream. On examining the bar coating, whether the coating be of chocolate, butterscotch, peanut, caramel, or some other flavor, the judge should consider its flavor, relative thickness, tenacity to the ice cream, brittleness, uniformity and appearance. He should note also the quality of the ice cream itself and if it is of the same quality as the bulk ice cream from the same company. Frequently the general appearance of the wrapper will give an indication of the heat shocking to which the ice cream may have been subjected.

Specials. Special ice creams such as pies, cakes and molds should be examined particularly on the surface. Decorations are often made with whipped cream. The whipped cream may be susceptible to oxidized flavor development which unless noted especially may be attributed to the ice cream.

Ices and Sherbets

Ices and sherbets differ from each other in that the latter contain milk or milk products while the former do not. These products are increasing in popularity each year and the ice cream manufacturer has become so proficient in their manufacture that it is sometimes difficult for the beginning judge to know with certainty whether he is judging a fruit ice cream or a sherbet. The beginning judge should know some of the differences which might be expected between ice cream and ices and sherbets. Sommer (1938) states that ices and sherbets differ from fruit ice cream as follows:

"1. Ices and sherbets are not nearly so rich as ice cream; ices contain no fat and serum solids, and sherbets contain much less fat and serum solids than ice cream.

2. Ices and sherbets are considerably sweeter than ice cream; the sugar content of ices and sherbets ranges from 25 to 35 percent.

3. Ices and sherbets have a tart (acid) flavor.

4. Ices and sherbets usually have a more pronounced fruit flavor.

5. Ices and sherbets have a much lower overrun; the overrun should be from 25 to 40 percent."

The defects of ices and sherbets are usually specific to the product, although some may be similar to those sometimes encountered in the dairy products.

Flavor. Generally, the flavor of ices and sherbets is distinctly that of a fruit of some kind. The flavor is usually pronounced which characteristic is not particularly objectionable when it has the quality of a fresh fruit flavor. Three flavor defects sometimes are noted in ices and sherbet. These are:

1. Unnatural. The unnatural flavor or lack of a true-fruit flavor is discriminated against in judging ices and sherbets. The defect is manifest by its artificiality. Often the flavor is not in keeping with the color. This defect will not be difficult to recognize.

2. Turpene. Sometimes ices and sherbets flavored with citrus fruits have a persistent, pronounced peel flavor resembling or suggesting turpentine to a marked extent. This flavor, commonly referred to as "turpene" is easily recognized. While it is desirable that the lime, lemon, or orange ice or sherbet carry a pleasing flavor, the flavor is severely criticized when it is so strong that it carries with it the persistent turpene flavor, which faintly suggests turpentine.

3. High-acid. Ices and sherbets are characterized by a high-acid, tart flavor. Sometimes this acid is so pronounced as to give a sensation of pain. After some of the product has been eaten the sensation of pain persists for some time. Such a flavor is not conducive to increased consumption. This defect is not associated with the highest quality ice or sherbet.

Body and texture. Ices and sherbets are liable to have the following specific body and texture defects which are not associated with ice cream:

1. Surface crustation. This defect is shown on the surface by a hard, spotty or continuous crustation of sugar. Immediately under the crustation a heavy syrup may appear. The defect is due to crystallization of the sugar brought about in part at least

by supersaturation as a result of drying. The extreme hardness of this material has caused it to be referred to as "petrified ice." Where the surface is well protected by a parchment cover little difficulty with this defect is encountered. Dahlberg (1926) described this condition encountered in his investigation of sherbets and ices as follows:

> "Throughout most of this investigation the excessive hardening of water ices and sherbets at the surface was never encountered because they were always kept covered in the hardening room. When water ices and sherbets were exposed to the air light colored spots appeared, first barely visible to the unaided eye and later so numerous and large that the entire surface was covered. As the spots grew in size eccentric rings were formed and the spots were slightly elevated on the surface of the water ices or sherbets. The spots also grew into the water ices or sherbets to the extent of one-fourth or one-half inch. These spots were so hard that they resembled solid ice in their character. They could not be broken with the ordinary spoon or knife, but when they were completely removed the frozen product beneath them was in good condition. The extreme hardness of the surface of water ices or sherbets which have undergone this change has caused this material to be referred to occasionally as 'petrified ice.'"

2. *Hard, brittle.* A hard, brittle ice and sherbet is characterized by its hardness and poor dipping ability as compared to ice cream at the same temperature. This condition is particularly noticeable in ice or sherbet-center packages. The product tends to break off in chunks resembling ice in many respects. The defect is very likely associated with too low a sugar content, but may be due in part at least to a very low overrun.

3. *Soft, spongy.* A soft, spongy ice or sherbet is the opposite of the hard, brittle defect. Such a defect is easily recognized. The defect is closely associated with a high sugar content and a high overrun.

4. *Separation, drainage.* Drainage of the unfrozen syrup or "bleeding" may occur in ices and sherbets if the product is not adequately stabilized or held at sufficiently low temperatures. The defect is easily recognized and, if present, may be noted readily in the packaged product when the package is removed or is cross-sectioned vertically with a sharp knife. In bulk goods the defect may not be noted with assurance, although suspected, until the contents of the container have been removed. Usually the liquid drained away is associated with a high color

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Review Questions

1. Distinguish between ices and sherbets.
2. In what major respect does plain and fruit ice cream differ?

3. What specific product is usually studied in the judging of frozen dairy products?
4. A frozen product containing milk products, a high sugar content and a low overrun would most likely be (a) vanilla ice cream, (b) parfait, (c) sherbet?
5. From the standpoint of gallons of ice cream sold, list in order of their importance the four most popular flavors.
6. Give the score card for judging ice cream.
7. What temperature is generally satisfactory for ice cream judging?
8. How is the melt-down of ice cream determined?
9. What constitutes a satisfactory melting quality of ice cream?
10. How may the relative coarseness or smoothness of ice cream be determined?
11. Name the color defects of vanilla ice cream.
12. A greenish discoloration in ice cream may be observed sometimes in judging (a) vanilla ice cream, (b) fruit ice cream, (c) chocolate ice cream, (d) strawberry ice cream.
13. List the major precautions in setting out samples of ice cream for a study of the melting quality.
14. Describe the appearance of melted ice cream which might be criticized as showing a curdled melting quality.
15. Distinguish between body and texture of ice cream.
16. Name the body defects of ice cream.
17. Name the texture defects of ice cream.
18. To what is sandiness in ice cream due?
19. What body and texture defects of ice cream are likely to occur most frequently?
20. Describe the desired flavor in vanilla ice cream.
21. Classify the off-flavors which may be present in vanilla ice cream.
22. Give the suggested grouping for off-flavors in ice cream with the range of score for each.
23. Name the four flavors likely to occur most frequently in vanilla ice cream.
24. Name the major flavor defects of chocolate ice cream.
25. Name the major flavor defects of strawberry ice cream.
26. How do ices and sherbets differ from fruit ice cream?
27. List the major flavor defects of ices and sherbets.
28. List the body and texture defects of ices and sherbets.

CHAPTER IX

JUDGING AND GRADING CREAM

Cream is a portion of milk into which the fat is concentrated, usually by centrifugal separation. It contains all the constituents found in the whole milk from which it was separated but these constituents are present in different proportions. Hand-skimmed cream generally will vary from 10 to 25 percent fat. Cream skimmed by centrifugal separation may vary from the percentage fat in very rich milk to a thick, plastic product testing 80 percent. The percentage solids-not-fat in cream varies with the percentage of fat and is approximately in inverse proportion to the percentage fat. Sweet cream has the same flavor characteristics as the whole milk from which it was separated, with the possible exception of those flavor defects that are primarily associated with the fat. The flavor defects associated with the fat are generally more pronounced in the cream than in the original milk.

KINDS OF CREAM

Creams differ, primarily, in the percentage fat, in the processing treatment, in bacteriological treatment, and in the use made of them. Sweet cream sold to the consumer as such, regardless of richness or previous treatment, is called market cream. Several kinds of cream are recognized commercially.

Table cream. Sweet cream, raw or pasteurized, containing 16 to 22 percent fat, according to the legal standards in the different states, is known as table cream. Table cream may or may not be homogenized. It is sometimes called "coffee" cream.

Whipping cream. Raw or pasteurized sweet cream containing 30 to 40 percent fat, which has been aged for a sufficient length of time to enhance its whipping qualities, is known as whipping cream. This cream is often referred to as "double" cream, because the percentage fat is about twice as high as that of table cream.

Ready-whipped cream. Whipping cream, raw or pasteurized, which has been flavored, whipped and delivered to the consumer in the whipped state, is known as ready-whipped cream.

Plastic (80 percent) cream. Plastic cream is a thick, viscous, semi-solid, raw or pasteurized, sweet cream containing from 70 to 80 percent fat. Plastic cream is produced by separating milk through a specially designed separator bowl under certain conditions. Plastic cream is used mainly for making ice cream mix. It may also be used in its natural state as a spread for bread or it can be used in a mixture with salt, honey, chocolate or peanut butter. Despite the fact that plastic cream sometimes contains a fat content up to the 80 percent, minimum legal fat standard for butter, it does not keep as well as butter, due primarily to the higher curd content.

Substandard cream. Substandard cream is a sweet cream product, pasteurized, containing from 10 to 12 percent fat, and usually homogenized at a pressure sufficiently high to inhibit the formation of a cream layer. It is also known by other names, such as "cereal milk," "cereal cream," "cereal treat" or "breakfast cream." Because it can be made by mixing equal parts of table cream and whole milk it is sometimes called "half-and-half." The trade names "Mel-O-Rich" and "Tasty-Rich" also refer to this kind of cream. Additional milk solids-not-fat may be added, depending on the dairy laws in the state where it is sold.

Frozen cream. Frozen cream is sweet cream containing from 50 to 75 percent fat carefully processed and stored at 0° F. to —10° F. (—17.7° C. to —23.3° C.) for several weeks or months. If it is fresh, of good quality, and properly processed, the cream may be held frozen for several months and still retain its original good flavor. Its main use is for making ice cream mix.

Devonshire cream. Devonshire cream is obtained by hand skimming shallow pans of scalded, whole milk. The whole milk, after standing 10 to 12 hours, is scalded for 20 to 30 minutes at about 190° F. (87.8° C.), then cooled, held 24 hours and skimmed. The cream prepared in this way has a definite characteristic flavor and body and texture. The butterfat content usually averages from 60 to 65 percent. It is referred to by many other names such as "clotted cream," "Devonshire clotted cream," "Cornish cream," "scalded cream" or "cooked cream."

Cultured cream. Cultured cream is a heavy, smooth, viscous, sour cream prepared by the ripening of pasteurized sweet cream with a clean-flavored, aromatic, lactic culture. It is sometimes

called "commercial sour cream," "Jewish sour cream," or "Hebrew cream."

Commercial sweet cream. Commercial sweet cream is high quality sweet cream purchased for use in ice cream mix or in other dairy products where a high quality sweet cream is required.

Churning cream. Churning cream is sweet or sour cream produced primarily for the purpose of being made into butter.

BOTTLED CREAM

Bottled cream should have a good flavor, be uniform in consistency, have a good physical appearance, and good keeping quality. It should be delivered in a clean, neat package adequately protected from contamination. Good cream is a sales builder for a dairy plant and high quality helps increase consumption. Due to handling and processing, cream is more subject to defects than many other dairy products. Physical defects lead to consumer dissatisfaction. Consumer dissatisfaction leads to a reflection on the quality of the other products handled by the plant. Consumer complaints about cream are usually relatively high. For these reasons, the judging of market cream is very important.

The score card for cream. The committee appointed by the American Dairy Science Association[3] to revise the milk score card considered a separate score card for market cream. The committee realized that it would be advisable to have such a card but did not have sufficient data to devise a card intelligently that would meet all the requirements. In a market cream score card such factors as viscosity, serum separation, cream plug, and whipping quality might well be considered. There are so many factors affecting these properties that have not been sufficiently investigated that the committee hesitated to include them in a market cream score card until some equitable means for scoring them could be perfected. Another problem that complicated the devising of a market cream score card was the question of how to compare creams of different fat percentages on the same card. Until these complications are solved and a score card is devised for scoring market cream, the committee recommended that the revised milk and cream score card shown in Chapter V of this text be used for both table and whipping cream.

Container and closure. The container and closure for bottled cream are examined and judged the same as for bottled milk. Details and the routine of judging these items have been fully discussed in Chapter V. While the judging of them is essentially the same for both products, some additional observations should be noted in judging the container and closure of bottled cream.

The fullness of the bottle should be observed closely. Air may be entrapped in cream bottled immediately after cooling and, due to further cooling and crystallization of the fat, the bottles may show slack fill after storage of 24 hours or more at 40° F. (4.4° C.). A slack-filled container of cream should merit a greater deduction than a similarly filled bottle of milk, because of the greater percentage of fat. Close inspection should be made for soiled containers. Since cream generally carries more color than milk it does not furnish the most suitable background against which the soiled surface may be seen. Waste cream is not so easy to rinse off the bottle as waste milk, hence the bottle of cream may show a greasy film on close inspection.

Physical examination of cream. The routine examination of fresh and stored sweet cream has much merit. Defects of cream often give rise to customer complaint and dissatisfaction. By thorough examination of the fresh product such as is sent out on the route and of the same product again after 48 to 72 hours' storage the defects may be encountered and corrected, thus avoiding dissatisfied customers. While many forms may be had to record the findings of a physical examination of cream, depending upon the various items being examined, the milk products examination report outline of Sealtest, Inc. which has been used successfully, is presented on an accompanying page as an example.

Acidity of sweet cream. The titratable acidity of all fresh cream should be consistent with the fat percentage of the cream. There exists an inverse relationship between the percentage of fat and the percentage of titratable acidity. Unfortunately, this relationship is not always fully appreciated. Since the titratable acidity of the freshly separated cream is always lower than that of the milk from which it was separated, those not familiar with this relationship often suspect that the acidity of the cream has been standardized. The titratable acidity of fresh cream may

Grade ....

SEALTEST, INC.
MILK PRODUCTS EXAMINATION REPORT

Company .... Plant .... Date ....

Product	Package		Cream		Sediment	Flavor	Body and texture
	Appearance	Fullness	Plug	Skim line			

SIGNED ....

be calculated if the percentage fat of the cream and the percentages of fat and titratable acidity of the milk are known. For example, if 4 percent milk has a titratable acidity of 0.15 percent and a 20 percent cream is skimmed from it, then the titratable acidity of the fresh cream can be calculated by the formula:

$$\frac{\text{Percentage serum in the cream}}{\text{Percentage serum in the milk}} \times \text{percentage acidity in the milk} = \text{percentage acidity in the cream}$$

Thus:

$$\frac{100-20}{100-4} \times 0.15 = 0.125 \text{ percent calculated titratable acidity of 20 percent cream}$$

The actual value resulting from titration will always be slightly higher than the calculated value, due primarily to the adsorbed proteins on the more numerous fat globules. The increase in acidity due to these adsorbed proteins will depend upon the method of sampling. Weckel (1935) demonstrated that results approximating the calculated values, but slightly higher, could be obtained by titrating a 9 ml. sample to which had been added the pipette rinsings, secured by filling the pipette once with distilled water. Gould (1941) demonstrated also, that in the case of sour cream, this method of sampling was rapid and that the results agreed closely with those secured on weighed samples.

Developed acidity in market cream is definitely objectionable and such cream is criticized severely. Developed acidity in cream favors feathering and impairs the flavor. Nair and Bentham (1938) suggest the upper limits of acidity permissible in cream to correspond to a serum acidity of approximately 0.18 percent. This means then that a 20 percent cream may have a titratable acidity not exceeding 80 $\times$ 0.18, or 0.144 percent. This standard seems very generous and allows for normal variations in the titratable acidity of milk throughout the year.

Sediment in cream. Any sediment in cream is objectionable. Despite the fact that most of the market cream bottled and sold today is obtained by the centrifugal separation of whole milk, a process essentially resulting in a clarified product, bottled cream, nevertheless, may exhibit some sediment. Cream may be examined for sediment by observing the sides and bottom of the glass container or by inspecting the sediment from a pint sample as collected on a cotton disc. The former method is

quick, simple and fairly accurate. If sediment is present, it will likely appear on the bottom of the container, although specks may be noted occasionally on the sides. By holding the glass container up to a good indirect light, as at a north window, and tilting it gently, any sediment present may be observed. In judging the cream for sediment, the amount, kind and size of the particles of the sediment should be considered the same as for milk. In preparing sediment discs of sweet cream for inspection the International Association of Milk Dealers (1935) suggest diluting a pint sample of the cream with an equal quantity of filtered hot water and filtering the mixture at a temperature of about 120° F. (48.9° C.). The sediment discs of cream are evaluated similar to those of milk, which has been discussed in Chapter V.

Bacteria limits. City and state milk ordinances usually specify requirements for different grades of market cream. These requirements are generally based upon the bacteria count and the sanitary conditions of production. The United States Public Health Service (1939) recognizes identical grades for cream as for milk except that the bacteria standards are doubled in the case of cream. So far as bacteria count is concerned, according to this ordinance, Grade A pasteurized cream may not exceed a bacteria plate count of 60,000 per milliliter and Grade B pasteurized cream may not exceed a bacteria plate count of 100,000 per milliliter.

TABLE CREAM

Flavor qualities. *High quality table cream should have a clean, sweet, pleasant, nutty flavor.* The cream is practically devoid of aroma, as the flavor is derived almost entirely from the taste reactions. Sweet cream is subject to the same flavor defects as milk. The flavor defects that are associated with milk fat are generally more pronounced in cream and those flavor defects that are associated with milk serum are generally less pronounced. The taste reactions of off-flavors in cream are similar to those for the same flavors in milk. However, in tasting cream, it must be recognized that the viscosity of the product gives rise to a feeling in the mouth different from that noted in tasting milk, which may at first be confusing to the judge not accustomed to tasting cream. Generally more time is required for tasting cream than for milk, due apparently to the retarded taste-reaction time of the more viscous product. The

flavor scores allowed for cream having various flavor defects should be comparable to those given to milk flavor defects by the panel of selected judges (Trout and Associates, 1942) and presented in Chapter V. The principal flavor defects of table cream are:

Barny. Cream having this flavor defect smells not unlike the interior of an ill-kept, insufficiently ventilated cow barn. The flavor is not pleasing as it suggests uncleanliness. The palate cleans up slowly after the sample has been eliminated from the mouth.

Bitter. The sharp, stinging sensation of bitterness is slightly delayed as the sample is placed in the mouth, but remains for a time after the sample has been eliminated. The bitter flavor may be caused by the cows having access to certain weeds, by the growth of micro-organisms, or by lipase activity. The bitter sensation is a part of the soapy or rancid flavor sometimes encountered in raw cream.

Cooked. Pasteurized cream may have a cooked flavor. This is especially true immediately after pasteurization. The cooked flavor intensity usually lessens as the cream ages. The flavor can be detected both by taste and by smell. Sometimes it is referred to erroneously as a "heated" flavor. Cooked flavor is becoming less objectionable in the opinion of dairy products judges, for it is a sign of good keeping quality and wholesomeness.

Feed. Many feeds, unless properly fed, are liable to cause a feed flavor in cream. Corn silage, alfalfa silage, green alfalfa, alfalfa hay, green rye, green cow peas and many other feeds will impart a typical feed flavor to cream if fed too soon before milking. To eliminate the danger of contaminating cream with feed flavor, the feeds should be fed either after milking or a sufficient length of time before milking to permit the feed effects to pass off. The feed flavor may be detected readily by the sense of smell.

High-acid. High-acid flavor is detected easily both by taste and by smell. A slightly high-acid flavor may be noted by its characteristically sour, slightly unclean odor. Fresh, sweet cream has a low initial acidity. This acidity is odorless and tasteless and is due to the acid reaction of some of the milk solids-not-fat and the carbon dioxide. The developed acidity resulting from

the growth of micro-organisms does have a typical flavor which can be detected easily although only a small amount may be present.

Oxidized. The oxidized flavor is a very common defect in pasteurized sweet cream. It can be detected by its typical wet cardboard-like smell and by the metallic, tallowy sensation when taken into the mouth. Various intensities of oxidized flavor may be noted. The flavor is usually of short duration after the sample is eliminated from the mouth. This flavor is more common in pasteurized cream during the winter months than during the summer.

Rancid. Rancidity can be described best by comparing its flavor with the odor of butyric acid. Rancid cream gives a soapy, bitter and very repulsive sensation. Raw cream contains the enzyme lipase, which under favorable conditions may split butyrin into glycerol and butyric acid, thus causing the rancid flavor. Cream from cows in the last stage of lactation, particularly during the winter months, seems to be more subject to the rancid flavor. Pasteurization of cream destroys the enzyme and guards against the cream becoming rancid.

Stale. Sweet cream stored for extended periods of time may develop a stale flavor. The flavor is characterized by a lack of freshness. Both the odor and the taste of the cream suggest old cream. A typical stale flavor persists after expectoration of the sample, whereas the oxidized flavor soon disappears.

Weedy. Weedy flavors are characteristic of certain weeds. The flavor is detectable immediately after the sample is taken into the mouth. If cows consume weeds with a strong flavor the flavor will generally be pronounced in the cream. Each weed causes a characteristic flavor specific for that weed. Weedy-flavored cream is generally not tolerated by the consumers as the objectionable flavor leads them to believe that the product is not wholesome.

Placing a flavor score on table cream. After the cream has been examined for flavor, the flavor should be evaluated. Placing an evaluation on flavor of cream showing specific flavor defects may be done according to the evaluation presented in Table 4 showing evaluation for similar flavor defects in milk.

Body of Table Cream

The body of table cream should be smooth, uniform and reasonably viscous for the percentage of fat present. When poured into hot coffee the cream should be readily miscible, showing neither "feathering" nor "oiling off." It should impart a desirable color to the coffee. The trade is so critical of the body of table cream that added responsibilities are placed upon the cream judge to recognize even the slightest defects in the body of cream. Some body defects are readily apparent to the eye, while others require not only physical examination of the cream but tests with hot coffee as well. The body defects of table cream apparent to the eye are:

Cream plug. A cream plug may be shown by (a) a lack of uniformity in the cream, particularly at the surface; by (b) a layer of frothy and sometimes heavy cream adhering to the bottle closure; by (c) buttery particles on the surface of the cream; and by (d) a distinct, heavy, often leathery plug obstructing the flow of cream from the bottle (Figure 81). The cream plug is not to be confused with ropy cream (Figure 82). Cream showing a definite cream plug often has a thin body. When such cream is poured into hot coffee droplets of butterfat generally are noted on the surface. The defect varies widely in its intensity. Nair and Bentham (1938) list the various intensities of cream

Figure 81 — A Foamy Cream Plug May Be Noted by Foam Adhering to the Bottle Closure as Well as by Failure of the Cream to Pour From the Bottle.

Figure 82 — Ropy Table Cream.

plug, in order of the seriousness of the defect, as: slightly soft, foamy plug; distinct, soft plug; buttery plug; and leathery plug.

Oily. Oily cream is inclined to be seasonal, being observed frequently when the cows have first been pastured on green grass. The defect in reality is closely associated with a cream plug for in the aggravated state a cream plug invariably forms. The cream having this defect appears shiny and usually has a thin body. The presence of a distinct skimmilk layer is common to oily cream.

Figure 83 — Skim Line on Bottled Cream.

Separation of a skimmilk layer. Separation of a skimmilk layer is very common in low fat cream. It results from the fat rising or creaming off. The defect is best described as a bluish, watery-like layer from one-sixteenth to one-half inch in depth at the bottom of the container (Figure 83). Its presence in cream connotes to the customer dilution with skimmilk or a high percentage of skimmilk in the product, which, however, is not the cause.

Two qualities must be considered

in observing the serum or skimmilk layer of cream, namely, the depth of the layer and its distinctness. The latter seems to be more serious than the former, for a relatively obscure, deep skimmilk layer is less objectionable than a distinct, shallow layer showing a pronounced line of demarcation.

Certain associations with a skimmilk layer may be noted in cream. Usually, cream having this defect does not have a thin body, but rather a relatively viscous body considering the amount of fat present. Sometimes an old, stale, oxidized flavor may be noted in the cream showing this body defect. The skimmilk layer in table cream becomes more distinct on longer storage.

Thin body. Thin body is quite common to table cream. It is manifest by a tendency to drip as it is poured slowly from the container and by definite splashing similar to milk as the cream is poured onto a surface from a distance of six inches or more. Thin body sometimes may be associated with cream plug, but rarely will it be associated with the separation of a skimmilk layer. While this defect is objectionable because it connotes to the cream customer a low fat percentage in the cream, it is not as serious as some other body defects.

Defects Which May Be Noted in Table Cream When It Is Added to Hot Coffee

Feathering. Feathering of cream is shown in several ways, depending upon the intensity of the defect. Such cream may appear nonmiscible in coffee, the cream rising in flocculent masses to the surface, thus showing a lack of homogeneity throughout. Frequently the defect appears as a light, evenly serrated scum on the surface after the coffee and cream mixture has come to rest. Occasionally the defect may be so serious that the cream rises to the surface of the coffee immediately after the cream has been poured into it, where it appears like chunks of sour cream.

Cream exhibiting feathering may have other characteristics associated with it. The cream may appear unusually smooth, relatively viscous and uniform showing no skimmilk layer. These desired qualities result from homogenization, which, if carried out at too high a pressure, makes the cream susceptible to feathering under certain conditions, particularly those associated with a high calcium content in the water. In addition, cream susceptible to feathering may be high in titratable acidity, of which developed acidity is no small part. The presence of developed

acidity will be reflected in a high-acid, or a slightly sour flavor. Regardless of the cause of feathering of cream in coffee, the consumer believes that the cream is sour.

Oiling off. This defect may be noted also after the defective cream has been poured into hot coffee. Instead of the cream giving to the coffee a distinct, uniform, light-brown color, the coffee appears slate-gray as though milk had been added to it. In addition, droplets of butter oil may be noted on the surface. The defect is closely associated with a cream plug and oily cream. Partial churning and coalescence of the fat globules may be observed in the cream. The defect will likely be more serious during the season of the year when the cows are on pasture.

Off or poor color in coffee. When sufficient cream is added to coffee it should impart a rich, creamy, golden-brown color. The ability of cream to lend the proper color to coffee is an important property. The rich appearance makes the coffee more appetizing. The shade of color obtained depends upon the number of suspended particles of sufficient size to reflect light and hence give the golden-brown coloring effect. The ability for cream to color coffee increases with an increase in fat and solids-not-fat and is enhanced by homogenization. If table cream does not give the coffee the right shade of color the consumer considers that the cream is low in butterfat. Cream with an oily body may give a slate-gray color to coffee.

Procedure for the Complete Examination of Table Cream

While it may be desirable to temper the cream to a temperature of about 60° F. (15.5° C.) if only the flavor of the sample were to be determined, it is preferable to begin the complete examination of the cream as it is removed from the refrigerator, making temperature corrections later if necessary. Carefully transfer the containers from the refrigerator to the laboratory in a vertical position, avoiding undue agitation. The order of examination should be as follows:

1. Serum separation. Examine the product closely for serum separation or formation of a skim line. Do not disturb the bottle. Notice both the depth of the skimmilk layer and its distinctness.

2. Sediment. Pick up the container gently and, before a good light, tilt it slowly to an angle of 45° and note whether any sediment moves across the bottom. Repeat, tilting the container from another side. Examine the cream for suspended sediment. If a

sediment disc is to be made, this must be done after all other observations and samplings have been completed.

3. Container and closure. Observe the container and closure, paying particular attention to fullness, cleanliness and general appearance.

4. Cream plug. Lift the closure and examine its underside for adhering cream. Pick up the container and tilt it slightly to see if the cream tends to resist pouring. With a sterile spatula or pipette, examine closely the cream adhering to the closure and the exposed surface of the cream for plug formation. Replace the closure tightly.

5. Bacteria count. Secure sample for bacteria count and plate it out according to the Standard Methods for the Examination of Dairy Products of the American Public Health Association. If it is necessary to warm the cream for sampling, then the sample for bacteria count should not be taken until after viscosity readings have been made. In such cases it is preferable to have a duplicate container of cream on which a bacteria count may be made.

6. Viscosity. Temper the cream and equipment to 50° F. (10° C.) and determine its relative viscosity in seconds by the Borden Body Flow Meter as described by Nair and Mook (1933).

7. Flavor. Pour 20 ml. into a 100 ml. beaker. Warm the sample to 60° F. to 70° F. (15.5° C. to 21.1° C.), if desired, by holding the glass beaker in warm water, and taste.

8. Acidity. Pipette out a 9 ml. sample of the cream. After emptying, draw 9 ml. of distilled water into the pipette. Add these rinsings to the 9 ml. of cream and titrate the mixture against N/10 NaOH using phenolphthalein as an indicator.

9. Feathering. Make specific examinations or tests for possible defects such as oiling off or feathering in hot coffee. Jenkins and Mack (1936) devised a method for examining cream to ascertain the extent of oiling off. The method, known as the Massachusetts State College test, was reported to have been used successfully in commercial laboratories. Basically, the test consists of centrifuging under specific conditions 1 ml. of the sample in a Babcock skimmilk test bottle with water at 200° F. (95.5° C.).

In checking the possibility of feathering, Sommer (1938) states, "If the results are to be comparable, it is necessary to

standardize all details of the test carefully. Adopt a uniform procedure with respect to the grade of coffee and fineness of grinding, proportion of coffee to water, the water itself, method of making the coffee, time and temperature of contact of the coffee with the coffee grounds, temperature of the coffee at the time of the test, the proportion of cream used, and the mode of addition.''

WHIPPING CREAM

Whipping cream usually represents but a small percentage of the sales of a milk plant, but that which is sold may give rise to a proportionally large number of complaints. In buying whipping cream, the housewife rarely questions its ability to whip but assumes that it will whip satisfactorily when she is ready to whip it, which is generally just previous to its use. Should the cream fail to respond readily to normal whipping, the matter is generally brought to the attention of the milk plant manager immediately. A milk plant cannot ultimately succeed with dissatisfied customers. Consequently, it behooves the superintendent of production to ascertain regularly the quality of the product sold. Certainly in the case of whipping cream, its whipping ability must be determined from time to time.

Qualities of whipping cream. Whipping cream may be scored using the same score card which is used in the scoring of table cream. The same quality factors applying to table cream apply also to whipping cream. Likewise, whipping cream is subject to the same defects as table cream, sometimes to a greater and sometimes to a lesser extent. In judging the quality factors of whipping cream one must be cognizant of and, therefore, considerate of the differences in fat percentages between table and whipping cream.

In general, *a desired whipping cream has a clean, sweet, nutty flavor, a relatively heavy body which is uniform throughout and a smooth texture.* The bacteria count, sediment and container and closure should be in keeping with those desired in table cream. Whipping tests should be made from time to time to supplement the observations made by organoleptic examination.

Percentage fat in whipping cream. As long as the percentage of fat in whipping cream conforms to the legal fat standard, the product cannot be faulted, despite the possibility of higher

percentages of butterfat in other samples. Research workers are in very close agreement that the percentage of fat in whipping cream should be between 30 and 35 percent. Such a cream may be expected to respond to whipping, yielding a reasonably stiff, stable, whipped cream of normal overrun.

Flavor defects of whipping cream. Flavor defects of whipping cream are very similar to those of table cream, which have been presented previously. In tasting whipping cream it is helpful to bear in mind that above all, whipping cream must whip. In order to improve the whipping qualities the cream may have been subjected to longer storage than common to table cream, which may be reflected in the development of a slightly defective flavor. For example, aging of pasteurized cream improves its whipping qualities. Likewise, time of storage is a factor in the development of the old, stale, and oxidized flavors.

Raw cream whips more readily than pasteurized cream. Despite a low bacteria count, raw cream may have present a bitter, rancid flavor due to the activity of the enzyme lipase.

Body defects of whipping cream. The whipping cream itself is subject to the same general body defects as table cream, but in different degrees. The viscosity, although higher than table cream, may be low, considering the percentage of fat present; the cream plug may be accentuated; the serum separation may be reduced to a minimum; and the feathering and oiling off may be of little consequence.

In addition to these possible defects, whipping cream is criticized severely if it does not whip satisfactorily. In examining this quality, at least four items must be observed, namely (a) time required to whip; (b) stiffness of the whipped product; (c) drainage or leakage; and (d) the volume increase, or overrun.

Checking complaints on poor whipping ability. Facilities should be available in every laboratory to enable the plant superintendent to ascertain quickly the whipping ability of cream without elaborate equipment (Figure 84). This equipment should consist of:

1. A good hand whipper such as the turbine or double-blade type.
2. A glass or crockery bowl of a size and shape that small samples of cream may be whipped.
3. A stop watch.
4. A thermometer.

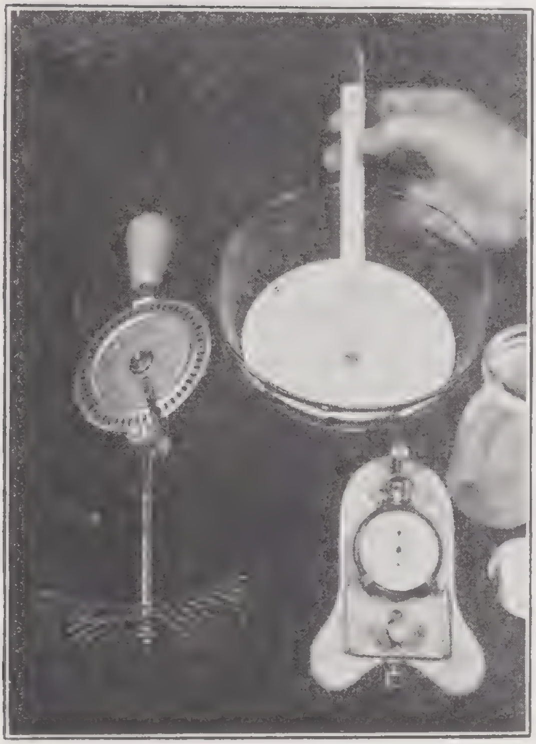

Figure 84 — Equipment for Cream Whipping Tests. Taking the Temperature Is an Important Step in Determining the Whipping Ability of Cream.

In attempting to whip the cream, the operator should be aware of the following guides to successful cream whipping:

1. Have the whipper, bowl and cream tempered to 40° F. (4.4° C.).
2. Whip only a small amount of cream, not over one-half pint, and use the same amount for each test.
3. Turn the whipper at sufficient speed to cause vigorous agitation and possibly some splashing of the cream. The rate of turning will likely vary with the kind of whipper used.
4. Avoid overwhipping. Stop the whipping process when the cream thickens, becomes "dry" and has a velvety appearance.

CULTURED CREAM

Cultured cream is a heavy, smooth, viscous creamy product resulting from the ripening of pasteurized sweet cream by the use of a good lactic culture. In large cities, particularly in centers of foreign population, there is quite a demand for cultured

cream. Since it is used as a spread or as a garnish for salads, it must have certain specific qualities of body and texture as well as a satisfactory flavor. These qualities are judged according to an ideal for the product.

Score card. There is no specific score card for cultured cream. While the score card for sweet cream meets the demand in scoring that product, it is hardly satisfactory for cultured cream. In scoring cultured cream one may use the proposed score card for cultured milk with a reasonable degree of satisfaction. However, since the body and texture of cultured cream are so important, the authors submit the following score card which should prove more suitable to the scoring of cultured cream than the proposed score card for cultured milk:

Proposed Cultured Cream Score Card

Factor	Perfect score
Flavor	45
Body and texture	35
General appearance	15
Package	5
Total	100

The proposed score card places the emphasis upon the qualities of flavor and body and texture, yet recognizes the general appearance and package.

Flavor of Cultured Cream

Cultured cream should have a rich, clean, pleasing, sharp-acid flavor. It should possess a delicate, subtle diacetyl aroma characteristic of a butter culture. In examining the flavor of cultured cream it is often a help to bear in mind that the flavor defects may be due to the use of poor raw products, poor culture, improper ripening or to prolonged storage. The chief flavor defects sometimes noted in cultured cream are:

Flat. Cultured cream having a flat flavor is almost entirely devoid of diacetyl. The flat sourness is pronounced. Such cultured cream lacks the rich pleasing flavor, despite its having been made from cream testing above 20 percent fat.

High-acid. A high-acid flavor is easily recognized by the slight painful sensation when a sample of the product is taken

into the mouth. Aside from the extremely sharp-acid flavor, no other flavor is detected.

Old, metallic, stale, tallowy. Infrequently, cultured cream may have an old, metallic, stale, somewhat musty or tallowy flavor. These easily recognized defects may be associated with mold contamination and growth, with prolonged storage, and with copper contamination.

Yeasty. A yeasty flavor is sometimes noted when cultured cream is held for a long time. A slight characteristic odor of yeasty fermentation is readily perceived in such a product. If the yeasty flavor is pronounced, gas formation can sometimes be detected by the appearance of the body.

Body and Texture of Cultured Cream

A good cultured cream should have a firm, heavy, smooth, uniform body which exhibits standing-up properties similar to that of slightly under-whipped cream. The body should not be so rigid that, upon spooning, the angular edges of the product retain their shapes as does whipped cream. On the other hand, Doan and Dahle (1928) point out that "the body should be so thick that the product is almost solid and the fluidity practically lost. At the same time, no 'wheying off' should be evident and the product should be homogeneous from the top to the bottom of the container."

Several defects of body and texture are often encountered in judging cultured cream:

Grainy or granular. A grainy cultured cream may be noted upon stroking the product with the edges of a spoon or upon pouring the product slowly from the container. The product showing this defect appears rough and watery. A noticeable lack of uniformity is apparent. Sometimes the defect is so serious that the product is actually lumpy.

Gummy. The characteristics of a gummy body are quite similar to those associated with a highly rigid body. In addition, the gummy product is tenacious, tending to follow the spoon as it is withdrawn from the surface and tending to resist as pressure is applied to the surface.

Serum separation, wheying off. This defect in cultured cream is shown by the presence of from one-eighth to one-half inch of a watery, whey-like layer in the bottom of a pint container of

the product. Such a defect will likely be accompanied by a grainy texture. Seldom will wheying off of cultured cream occur at the surface, as is frequently the case in cultured buttermilk.

Too rigid. This defect is just the opposite of a weak body. It is easily identified, as such cream stands up rigidly, thus appearing like jelly. The angular edges of spooned cultured cream having this defect tend to retain their angularity.

Weak. This defect is manifest by a marked flattening out of the product as a spoonful of it is poured gently onto a surface or when it readily becomes a part of the product as it is returned to the bulk of the cultured cream. Such cultured cream has a body very similar to that of a good culture, which is slightly less viscous than that desired in cultured cream.

General Appearance

Cultured cream should present a clean, natural-color appearance. The natural color may range from a white to a decided golden yellow, depending upon the seasonal color of the cream from which it is made. The surface should appear dry and smooth, thus yielding a velvety lustre. Inasmuch as the product is so viscous sedimentation does not occur. However, sediment, if present, may be noted sometimes next to the sides of the container.

FROZEN CREAM

Frozen cream, a comparatively new product on the market, is used largely in the manufacture of ice cream. The fat in cream intended for frozen storage usually ranges from 50 to 75 percent. If properly processed and of good quality, cream may be kept frozen several months, and still retain its original good flavor.

The flavor examination of frozen cream immediately preceding its use is very important. This may be done not by defrosting an entire container of the cream and tasting it, but by sampling the frozen product by means of a butter or cheese trier, ice pick or chisel. Since Baldwin (1932), Trelogan and Combs (1934), and Baldwin and Doan (1935) showed that cream containing above 25 to 30 percent fat froze homogeneously and that it could be reliably sampled in the frozen state, chipped samples may be tasted with the assurance that the sample, so far as the fat was concerned, is representative of that of the entire container. In securing the samples for tasting, care should be

taken to discard the surface layers for the surface layer may be a carrier of an absorbed flavor which is not characteristic of the cream as a whole. Each lot should be sampled and tasted separately. Particular attention should be directed toward the possible presence of old, stale, oxidized or tallowy flavors which may have developed during storage. In fact, some processors have the frozen cream scored at intervals during storage, removing from storage that cream in which a suggestion of oxidized flavor is noted.

Frequently, from 10 to 15 percent sucrose is added to cream prior to freezing for the purpose of reducing oiling-off upon defrosting. The presence of this sugar should not interfere with the judging of frozen sweet cream. In judging frozen sweet cream for flavor one should look beyond the distinctly sweet taste to ascertain the flavor of the dairy product. To the inexperienced judge the presence of sucrose might tend to mask or obscure other flavors, particularly if he were unaccustomed to scoring such products.

The body of the cream in the frozen state should not be oily despite some oiling off which will likely occur upon defrosting and subsequent heating. Oiling off of cream, although not desired, is tolerated to a certain extent in judging frozen cream. Some wheying off may occur following defrosting, thus leaving the solids more or less mealy and granular. These characteristics are not desirable.

MISCELLANEOUS CREAM PRODUCTS

In addition to table, whipping, cultured and frozen cream other cream products are on the market. These cream products are increasing in commercial importance but no official score cards have been devised for them. They have definite flavor and physical qualities and are subject to certain defects. These products, usually packaged, are ready-whipped cream, plastic cream, substandard cream and Devonshire cream.

Ready-Whipped Cream

The dairy inspector and dairy products judge frequently have the opportunity of passing judgment on ready-whipped cream, both as it is used on ice cream and on pastry specials and in bulk at soda fountains. The desired qualities of ready-whipped cream conform to those of freshly whipped cream.

The flavor in particular must be clean, fresh and well blended with the sugar and flavoring used. Two major defects of flavor are sometimes noted, namely, a staleness approaching the true oxidized flavor, and a lack of blend of the flavors of the cream, the sugar and the flavoring. If either the sweetness or the flavoring is too pronounced, the product should be criticized.

The body of ready-whipped cream should be relatively stable and firm, retaining the serum completely, thus showing no drainage. The texture should be smooth and the air cells fine. The inspector should look carefully for serum separation, oily or granular texture and large air cells, all of which are not conducive to the highest quality product.

The temperature of bulk, ready-whipped cream is so important in the maintenance of a quality product that it should be checked. If found to be above 40° F. (4.4° C.) the product should be criticized for too high a temperature.

Plastic (80 Percent) Cream

In judging plastic cream, one should bear in mind that it is a product subject to the flavors common to the milk from which it was skimmed. If the cream is held several days following production before it is pasteurized, a bitter, rancid flavor may be noted. Should the product have been pasteurized either as milk or cream it will not exhibit any rancidity, but may have an oxidized flavor.

So far as body and texture are concerned, plastic cream usually has a relatively firm, semi-solid body and a smooth texture. An oily texture is severely discriminated against.

Inasmuch as the cream is a high-fat product, a maximum amount of fat in the form of cream may be stored in a minimum of space. Consequently, plastic cream lends itself well to frozen storage. Only the highest quality cream should be stored in this manner. Therefore, it becomes necessary to examine carefully each lot of plastic cream to ascertain its flavor qualities.

Substandard Cream

Substandard cream should be judged for the same general standards as previously discussed for table cream. Leniency should be shown, however, with some items and special stress placed on others. For example, the product should not be criticized severely for having a thin body. In fact, a thin body is

to be preferred rather than a body more viscous than is common to the higher-fat product, table cream. Also, slight feathering in coffee should not be condemned too seriously for it must be recognized that the mixture has been homogenized primarily to produce homogeneity and to increase the viscosity. The homogenization pressure may have been sufficiently high to contribute to feathering. On the other hand, a very careful examination should be made to ascertain the presence or absence of a flocculent, smudgy sediment at the bottom of the container, very similar to that sometimes noted in homogenized milk. A careful examination should be made also of the upper portion of the product to determine the presence or absence of a cream layer, cream plug, or any fatty particles or foam which would be indicative of a lack of homogeneity throughout. There is no particular objection to some fat rising in the product so long as neither a cream nor a skimmilk layer is formed. It is not expected that this product will retain its complete homogeneity as is expected of homogenized milk.

Devonshire Cream

Sadler (1917) gives the qualities of clotted (Devonshire) cream as follows:

> "As regards the qualities required in a typical sample of clotted cream, it must be granular in texture; it should be firmer than the thickest of cream obtained from a separator, but not so firm as a freshly made cream cheese; the colour should be golden, not unlike the colour of the butter made from pure-bred Guernsey cows. The cream must not be too wet or 'mushy,' or if so it ceases to be characteristic; moreover, if too much moisture is present it indicates an excess of scald milk incorporated in the cream, and the keeping qualities are thereby considerably impaired. The cream must have a nutty taste, and a decided scalded flavour pleasing to the palate."

While Devonshire cream is largely a product of the counties of Devonshire and Cornwall, England, it is, nevertheless, a commercial product in some sections of the United States. The writers had occasion to judge some samples of clotted cream which were being produced on a commercial scale. Two defects were particularly noted:

High-acid flavor. The high-acid flavor, although clean, was so pronounced as to obscure the rich, cooked, nutty flavor characteristic of clotted cream. Golding and Morgan (1940) noted

also a slightly bitter or slightly sour taste in Devonshire cream which had been stored frozen.

Wet, soggy, mushy body. The defect was manifest by a very soft, almost slushy, texture entirely unlike the relatively firm body and granular texture desired in clotted cream.

GRADING MANUFACTURING CREAM

Dividing cream into lots, on definite quality standards, according to the quality of the product that can be made from it when processed or manufactured is known as "grading." The grading of cream for manufacturing is the first important step in the control of quality in the manufactured product. In order to grade cream intelligently the grader should be able to recognize the many defects in cream, their intensities, causes and behaviors in processing, and how the different defects affect the quality of the finished product.

Fresh, sweet cream skimmed from fresh, sweet, clean-flavor milk with a clean separator and properly cooled and stored at a low temperature in a clean suitable container is at its best for manufacturing or processing into dairy products. As the cream ages and becomes sour it deteriorates with accompanying flavor defects. The souring and deterioration accelerates progressively as the cream becomes older, until the flavor is so objectionable that it cannot be used to make an edible product.

The souring and deterioration are much faster and progress much more rapid with age if the cream is held at a high temperature. Flavor defects inherent in the milk will be carried into the cream. If cream is exposed during storage to a strong odor for an extended period the odor may be absorbed in the cream, giving it an objectionable taint. Consequently, cream grading is based on flavor defects found in the cream, flavors that may have been absorbed, the age of the cream, and the percentage of acid in it.

Unlike the grading of other dairy products, the score card is not generally used in grading cream for manufacturing purposes. However, Mortensen (1938) presented a score card which was used successfully in the cream improvement program in Iowa. This score card recognizes four factors: Flavor, acidity richness and body and cleanliness. The score card follows:

Manufacturing Cream Score Card (Mortensen)

Flavor	45 points
Acidity	25 points
Richness	20 points
Body and cleanliness	10 points
	100 points

Flavor is allowed the same number of points as the flavor on the butter score card and the flavor is graded in accordance with the flavor quality of butter that could be made from the cream if properly processed. The acidity is given a perfect score if the acid is 0.2 percent or less. One point is deducted for each 0.1 percent acid in excess of 0.2 percent. Richness is given a perfect score if the cream tests 28 percent fat, or above. One point is deducted for each percent below 28 percent fat. Body is given a perfect score when it is smooth, uniform, free from sediment, curd and fat particles. The container must be clean, free from rust, and in good condition.

The Mortensen score card is very helpful in conducting churning-cream scoring contests, checking up on producers' cream and in improving the quality of creamery butter.

Grading Commercial Sweet Cream

Sweet cream to be processed or manufactured into other dairy products should be of high quality. It should be low in acidity, clean in flavor, fresh, and delivered to the dairy plant in a clean, sanitary container adequately protected from contamination and without any marked rise in temperature while in transit. The quality of the products made is definitely influenced by the quality of the sweet cream used. The cream should be of such high quality that it would add rather than detract from the flavor desired in the finished product. In the selection of sweet cream for market cream, for ice cream mix, for creaming cottage cheese or for making other dairy products that require sweet cream, the following factors should be considered:

Acidity. The acidity of sweet cream is discussed at the beginning of this chapter. The titratable acidity should be less than the titratable acidity of the milk from which it was skimmed. If the percentage fat in the original milk is known

and the percentage fat in the cream is determined, the percentage titratable acidity can be calculated by using the formula given on page 302. By calculating the percentage of apparent titratable acidity and then by titrating the cream, it will be possible to determine whether any appreciable acidity has been developed in the cream due to the action of micro-organisms. Developed acidity is detrimental to the fine, pleasing flavor in sweet cream and interferes with a good blend of flavor in the manufactured product. Twenty-hundredths of one percent should be the absolute upper limit tolerated for sweet cream. A lower percentage acidity will result in a superior quality product and, therefore, is to be preferred.

Flavor. The flavor should be clean, fresh and have no off-flavors such as barny, bitter, feed, oxidized, rancid, stale or weed. If any of these flavor defects are present they can be tolerated only if present to a *very* slight degree. Much to the contrary of general opinion, the pasteurization of sweet cream does not appreciably decrease the intensity of the off-flavors. Pasteurization may enhance some of them. Furthermore, as the product manufactured from cream with a flavor defect ages, the flavor blend becomes less desirable.

Freshness. Cream is at its best when it is fresh. Although the cream may be held at a reasonably low temperature, acidity slowly but gradually develops in it. This developed acidity not only detracts from the fine characteristic flavor of the cream, but the by-products formed by slow chemical change are also detrimental to the finest quality in the manufactured product. It is very desirable to have sweet cream delivered to the plant daily. Delivery every other day should be the maximum age allowed for sweet cream.

Temperature. In order to protect the desirable flavor qualities and to retard bacterial growth, cream should be cooled immediately after separation and held cold until it is used. Cream inadequately cooled or improperly held will not give the best satisfaction for use in the manufacturing of dairy products where good sweet cream is needed. The grader should insist that the temperature of the cream be no higher than 45° F. (7.2° C.) when delivered to the plant. Credit should be given for cream delivered below this temperature. On the other hand, cream should not be frozen before it is processed.

Grading Cream for Buttermaking

Both sweet and sour cream are used for making butter. Butter made from sweet cream usually grades higher than that made from sour cream. Due to intermittent production of cream from small herds, distances from dairy plants and lack of proper care of cream, more sour cream is available for buttermaking purposes than sweet cream. Consequently, on the basis of percentage distribution the grader will likely encounter in some sections more sour cream and sour-cream butter than sweet cream and sweet-cream butter.

Cream for buttermaking is graded in accordance with the grade of butter that can be made from it if properly processed. A study of the flavor defects and flavor defect intensities permitted in each grade of butter (Chapter VI) shows that some of the flavor defects in butter are derived from the cream, others result from faulty processing or churning of the cream, while still others are developed in the butter after it is made. The following flavor defects found in butter are derived wholly or in part from the cream.

Barny	Fruity	Onion, garlic or leeks
Bitter	Heated	Smothered
Cheesy	Metallic	Stale
Coarse-acid	Musty	Utensil
Feed	Old-cream	Vegetable (cabbage, potato, rape, turnip)
	Yeasty	Weedy

Flavor Requirements of Cream for Making the Different U. S. Grades of Butter

U. S. grade AA, or U. S. 93 score butter. Cream for the U. S. grade AA butter must be clean in flavor, but may have a slightly normal feed flavor.

U. S. grade A, or U. S. 92 score butter. Cream for the U. S. grade A butter may have slightly coarse-acid, smothered, heated-cream (summer defect), or definitely normal feed flavors.

U. S. grade B, or U. S. 90 score butter. Cream for the U. S. grade B butter may have flavor defects as follows: slightly weedy (common), musty, vegetable (cabbage, potato, rape, turnip), or definitely old-cream, coarse-acid, utensil, and bitter.

U. S. grade C, or U. S. 89 score butter. Cream for the U. S. grade C butter may have the following flavor defects: slightly

obnoxious weed, onion or garlic; definitely barny, cheesy, fruity, metallic, musty, stale, vegetable (cabbage, potato, rape, turnip), and yeasty.

U. S. Cooking grade. Cream for the U. S. Cooking grade butter may have the following flavor defects: Definitely obnoxious weed, onion or garlic; pronouncedly cheesy, fruity, stale and yeasty.

U. S. "No grade" butter. Cream with a decomposed or a rancid flavor, or cream that has a moldy flavor should be rejected, as the butter churned from it will be classed as "No grade." Cream with a chemical, gasoline, kerosene, fly spray, paint or varnish taint, or having other objectionable, absorbed, foreign flavors should also be rejected as the resulting butter will be "No grade."

Acid Requirements of Cream for Making the Various U. S. Grades of Butter

In general, the highest scoring butter is made from sweet cream, a good grade of butter is made from slightly sour cream, and the lower grades of butter are made from definitely sour cream. However, acidity alone is not a good basis for dividing cream into the quality grades required to make the different U. S. grades of butter. Cream cannot be divided intelligently into grades entirely on the basis of the percentage acid in it. The percentage acidity does measure the stage of bacteriological fermentation which has a definite bearing on the resulting butter. Along with the percentage acidity the different flavor defects that lower the grade of the butter must be considered. Some of these flavor defects are the result of bacteriological activity which develop simultaneously with the acid while others have no relationship to the bacterial development in the cream. For these reasons, both the percentage acid and the flavor defects must be considered concurrently in grading cream for buttermaking.

Cream acidity for U. S. grade AA, or 93 score butter. In addition to the flavor quality previously described, the average acidity of the mixed cream in the vat should not exceed 0.20 percent. Vats of cream testing above this acid limit at the time of pasteurization begin to show coarseness and other flavor defects that jeopardize the flavor of the butter sufficiently so that it will not be AA grade, or 93 score.

Cream acidity for U. S. grade A, or 92 score butter. The vat test of mixed lots of cream should be limited to 0.30 percent acid. This allows for some developed acid in the cream. The acid developed in the cream must be clean; even then the acidity must be carefully standardized before pasteurization, as only slightly coarse-acid flavor is allowed in this grade of butter.

Cream acidity for U. S. grade B, or 90 score butter. As the acidity in cream increases past the limit for U. S. A-grade, or 92 score butter, more by-products are formed in it. The acid is approaching the percentage range where it is definitely sharp to the taste. By this time the cream generally shows a little age and the butter flavor in the fat is somewhat masked by the flavors of the by-products formed. If the average percentage acid of the different lots of cream in the vat is not allowed to go above 0.60 percent the cream should still make a 90 score butter if the acid flavor is clean and the cream is very carefully standardized for acidity before it is pasteurized.

Cream acidity for making the lower grades of butter. When an acidity above 0.60 percent is formed in cream, the bacterial fermentation has developed so far that the fat has lost much of its fine flavor. In such cream micro-organisms other than acid-forming types begin to develop, yielding so many off-flavors that the percentage acidity is no longer a factor in grading cream for U. S. grade C, or 89 score, or for butter grading below this standard. It is not uncommon to find in this grade of cream such flavors as fruity, yeasty, or cheesy which are formed by micro-organisms other than the *S. lactis* type.

Age

Cream is at its best for buttermaking when it is sweet and fresh. As it ages, it becomes progressively less desirable for making high-scoring butter. Although age is not taken directly into consideration in grading cream to make butter, its physical appearance due to age is a very good clue to some of the flavor defects and also to the acid content.

Temperature

Temperature, like age, is considered indirectly in grading cream but it helps the grader to appreciate more fully why certain flavors and physical defects are present. Cream held at a

high temperature deteriorates rapidly. Cream held at room temperature will deteriorate as much in a few days as cream held at a low temperature will in a much longer period of time.

Defects in the Flavor of Churning Cream

Sweet cream, promptly cooled after separation and kept cold until and during delivery to the butter plant, will, with careful processing, make a U. S. grade AA, or 93 score butter. To give butter the place it rightly deserves, real effort should be made by cream producers and buttermakers alike to make a very high-quality, fine, pleasing-flavored product that will enhance the flavor of all foods to which it is added. Unfortunately, in the production and handling of cream, flavor defects develop that jeopardize the flavor of the finished product. The flavor defects to look for in churning cream are:

Barny. A barny flavor in cream is considered to be a very objectionable flavor defect because it is readily transmitted to the butter. The odor suggests the contamination of the cream with some foreign, unclean material similar to that of air from a poorly kept cow stable. Several causes are suggested such as unclean udders, milking with wet hands, the growth of undesirable bacteria in the cream which may have originated from the digestive system of the cow, or poor stable ventilation. The barny flavor is persistent after the sample has been expectorated.

Bitter. Bitter is one of the four basic tastes and should be easy to detect. Cows late in lactation, and fed on dry feed may produce milk which when separated may result in cream which develops a bitter flavor readily when held at a low temperature. Some temperatures of cream separation favor or induce the development of rancidity in it. The bitter flavor and the rancid flavor are closely related when caused by the action of the enzyme lipase. The bitter flavor may be due also to the growth of certain micro-organisms which bring about changes in the protein. Likewise, it may be caused by some feeds consumed by the cows. The bitterweed *(Helenium tenuifolium)* consumed by cows causes a bitter flavor in cream which cannot be removed by heating and aeration. Usually the sense of smell gives little indication of the presence of a bitter flavor.

Cheesy. The lactose in cream held at a high temperature is rapidly changed to lactic acid by lactose-fermenting bacteria. When the acidity thus formed increases to 0.8 to 0.9 percent the lactose-fermenting organisms find biochemical conditions un-

favorable for further development. Proteolyzing types of bacteria may then break down some of the precipitated casein thus resulting in a cheesy flavor. This cheddar cheese-like flavor may vary in intensity but can be easily detected both by smell and by taste. When the sample is expectorated the aftertaste resembles that of the aftertaste from cheese.

Coarse-acid. The initial or apparent acidity of fresh, sweet cream is due to the acid reaction of the casein, albumin, citrates, phosphates and carbon dioxide. The initial or apparent acidity of cream is low, usually ranging from 0.10 to 0.14 percent, and has no detrimental effect on the flavor of the cream. As cream ages, especially at room temperature, lactose-fermenting bacteria begin to transform the lactose into lactic acid. As the lactose fermentation (souring) advances, the cream begins to taste sour, accompanied with a typical sour-cream aroma. Since lactic acid is nonvolatile, it is largely responsible for the sour taste, but the by-products formed are responsible for the typical sour-cream odor. The development of acid in cream, even though the acid in the cream is carefully standardized before pasteurization and churning, gives the resulting butter a coarse-acid or coarse flavor. The higher the acid in the cream the more intense will be the coarse-acid flavor in the butter. As the cream becomes older, the acid flavor is masked by other flavors that are more objectionable. Cream between 0.21 and 0.30 percent acid that is otherwise clean in flavor may produce butter that is slightly coarse, even though the acid in the cream is properly standardized before processing. Accordingly, clean-flavored cream between 0.31 and 0.40 percent may produce butter that is definitely coarse in flavor. The coarse-acid flavor clears up readily after the sample has been expectorated.

Feed. Some feeds give cream a characteristic flavor. These flavors are generally seasonal in that they are more prominent in certain seasons of the year. Some producing sections have specific feeds which are apt to taint the cream. Some tolerance is made, therefore, for normal feed flavors when judging cream in the different sections. For that reason, the term "normal feed" is used, which refers to normal for the season and for the producing section. Each feed flavor has a characteristic of its own. Although normal feed flavor is not very objectionable, it is noticeable and if present should be criticized. If the grader

becomes accustomed to the characteristic flavor of the different feeds he should have no trouble in identifying them, when they are present in cream.

Feed flavors can be eliminated largely, if not entirely, from cream if the cows are not allowed access to the flavor-producing feed for a period of at least three hours before milking. Feeding after milking usually will prevent entirely all possible chance of a feed flavor in the resulting cream.

Fruity. Cream with a fruity flavor has a sweetish, decayed odor somewhat like that of spoiled fruit. The flavor is disagreeable and is persistent after the sample has been expectorated. It is a serious defect and may occur in old sour cream that has been held at a high temperature. The fruity flavor is due to by-products formed by the growth of undesirable micro-organisms.

Heated. Heated-cream flavor is primarily a summer defect. It is associated with the odor of poorly-ventilated cream cans which are exposed to the hot summer sun. This is especially true if the closed, empty containers were not sufficiently aired before refilling them with cream. The flavor may also be caused by the growth of bacteria. The heated cream flavor is somewhat similar to the so-called "smothered" flavor in that it suggests the delayed or non-removal of animal odors from the cream. This flavor defect usually does not linger long on the palate after the sample is expectorated.

Metallic. Lactic acid formed from lactose by lactose-fermenting bacteria will react with iron or copper to form a salt of the metal involved. This metallic salt in cream gives rise to a puckery, astringent sensation when taken into the mouth. The metallic flavor is similar to that noted when rusty iron nails are held in the mouth long enough for the saliva to act upon them. The flavor may also be accompanied by a slightly bitter taste. Metallic flavor in cream can be very well demonstrated by tasting the discolored grayish-brown colored cream found around the lower edge of the can lid and also around the inside of the neck of a worn, rusty cream can.

Musty. When cream is kept unprotected in a poorly ventilated cellar for some time it will absorb odors from the surrounding atmosphere resulting in a musty flavor. Sometimes this flavor is referred to as vegetable-cellar flavor and resembles that of musty hay. The flavor is very noticeable both by the

sense of taste and by the sense of smell. After expectorating the sample, the musty flavor lingers on the palate.

Old-cream. This flavor defect is commonly encountered in cream that has been held for several days. It is primarily a defect in sour cream. However, it can develop to a slight degree in sweet cream that is held for a long time at a low temperature. Decomposition products are formed when cream sours. The longer the cream is held the more decomposition products are formed in it. These products are, no doubt, indirectly responsible for the old-cream flavor. Old-cream flavor is characterized by a decided lack of freshness and a persistent old taste.

Onion, garlic or leeks. When wild onion *(Allium canadense L.)*, wild garlic (*Allium vineale L.*) or wild leeks (*Allium tricoccum)* are consumed by cows the cream is generally badly tainted with their odor. This is especially true if these obnoxious weeds are consumed by the cows just before milking. The flavor will be very much less intense in the cream if they are consumed several hours before the cows are milked. As a rule, cows will not eat onion, garlic or leeks unless they are very hungry and do not have a more palatable feed available. These flavors in cream should be avoided as the use of such cream will produce a very low grade butter not acceptable by most people as table butter.

Smothered. Cream having this flavor defect, commonly referred to as "smothered," lacks freshness. It has an odor somewhat like that of fresh uncooled milk. Smothered flavor may be due to keeping the cream in a damp, musty, poorly ventilated cellar, or in a tightly closed, poorly washed container. It has been very generally attributed to delayed or improper cooling of cream. Later evidence suggests that it is a storage rather than a cooling defect. The defect seems to be detected more readily by smell than by taste.

Stale. Old, sour cream often has a stale taste and odor instead of the fairly clean, lactic acid flavor characteristic of clean, sour cream. The flavor of stale cream suggests more decomposition than that of old cream. The flavor does not clean up as well after expectorating the sample as does that of clean, sour cream.

Utensil. The utensil flavor is somewhat like the smothered flavor; the former suggests uncleanliness, whereas the latter suggests lack of freshness or need of aeration. If cream is stored

in improperly washed cans it develops a somewhat unclean flavor. The odor is not unlike that noted by smelling an improperly washed cream can that has been closed tightly for some time. Utensil flavor is more likely to occur in cream that has been stored in cans that have not been properly dried. This is especially true if the cans are dented, pitted or rusty.

The flavor is apparent as soon as the cream reaches the palate and intensifies if held on the palate a few seconds. It also lingers a short time after the cream is expectorated.

Vegetable. If the cows consume cabbage, potatoes, rape or turnips shortly before milking the cream separated from the milk will consequently have a flavor typical of the vegetable eaten. The flavor can be detected very readily both by taste and by smell. Indiscriminate feeding of these vegetables to cows is not conducive to the production of high-scoring butter from the cream. When it is necessary to feed such feeds they should be fed after, rather than before milking.

Weedy. A weedy flavor in cream will result in the same weedy flavor in the butter made from it. The less objectionable of the weedy flavors found in cream are those caused by the common weeds such as ragweed *(Ambrosia artemisiifolia L.)*, shepherd's purse *(Capsella bursa-pastoris)*, or wild lettuce (*Lactuca scariola L.*) which are found in most producing sections. Flavors caused by obnoxious weeds such as wild mustard *(Brassica arvensis)* or French weed (*Thlaspi arvense L.*) are more damaging because they carry more of an objectionable flavor into the butter. Each kind of weed has its typical flavor which may be detected easily by both taste and smell.

Yeasty. When sour cream is held at a high temperature, the growth of lactose-fermenting yeasts is encouraged. In the fermentation process, carbon dioxide is formed rapidly and the cream becomes foamy. It is not uncommon for the fermenting cream to push the lid off the can and allow the cream to effervesce over the top and down the sides of the container onto the floor. In the fermentation a typical yeasty odor is developed in the cream resembling that of a commercial yeast used for leavening bread. The yeasty odor is associated with a sharp-acid taste.

The Cream Grading Routine

Before attempting to grade cream, the grader should have in mind the flavor defects and the flavor defect intensities allowed

in each grade of cream. This is given, along with the acid limits of each grade, in Table 25. He should then proceed, having definitely in mind the score of the butter to be made from each grade of cream he is selecting.

After the cream has been weighed, stirred and sampled for the fat test, the cans should be lined up for grading. By observing the general appearance of the cream and by smelling the cream that sticks to the underside of the lid of the can, the cream can be divided into three general groups: (a) the high-grade, sweet or slightly sour cream; (b) the sour, coagulated cream; and (c) the low-grade, definitely sour, fermented cream.

The grader should be provided with a solid glass or plastic rod, or a small spoon for sampling, and a small container of clean warm water or warm tap water for rinsing off the sampler between samples. Provision should be made for expectorating the sample after tasting. For this purpose a pail partly filled with water, sink with running water, or a dentist's cuspidor are satisfactory. The expectorated cream should be washed away or kept under cover during the grading operation. The cream grader should wear clean, light-colored, washable clothes and a cap. He should wash the hands just before beginning to grade and do everything in keeping with the making of a clean, wholesome, nutritive butter product for which he is about to select the cream.

Technique of grading. Insert the sampling rod into the cream to the depth of about two inches, gently stirring meanwhile to temper the rod so the cream will adhere more readily and to insure securing a representative sample. Withdraw the rod quickly and put the cream into the mouth. Spread the cream on the palate and note the flavor. Determine whether the cream is sweet or sour to the taste. If sweet, does it have any flavor defect? If sour, about what is the degree of acidity? If the acid flavor is clean, are there any other flavor defects present? Expectorate the cream and note the after-taste in the mouth. Does the palate clean up or does the "off-flavor" present linger for a while? From the flavor impression and the degree of acidity, place the cream into its proper grade according to Table 25. In case of doubt as to the approximate percentage of acidity, check the percentage by titration. Follow this routine until all the cream is placed into the proper grade.

Table 25 — The Cream Flavor Defects and the Flavor Defect Intensities Permitted in Each Grade of Cream Selected to Make the Different U. S. Grades of Butter

U.S. Grade of butter for which the cream is selected	Feed	Heated-cream	Smothered	Bitter	Coarse-acid	Utensil	Old-cream	Cabbage	Turnip	Potato	Rape	Weedy (Common)	Musty	Fruity	Yeasty	Cheesy	Metallic	Stale-cream	Barny	Obnoxious weed	Onion or garlic	Maximum percent acid of mixed lots of cream previous to pasteurization
U.S. Grade AA, or 93 score	sl.																					0.20
U.S. Grade A, or 92 score	def.	sl.	sl.	sl.	sl.																	0.30
U.S. Grade B, or 90 score				def.	def.	def.	def.	sl.	sl.	sl.	sl.	sl.	sl.									0.60
U.S. Grade C, or 89 score								def.	def.	def.	def.	def.	def.	def.	def.	def.	def.	def.	def.	sl.	sl.	No acid limit
U.S. Grade CG, or below 89 score														pron.	pron.	pron.		pron.		def.	def.	No acid limit
No Grade	Cream that is decomposed, rancid, moldy or tainted with paint or varnish, gasoline, kerosene, fly spray, or having other objectionable absorbed foreign flavors.																					

Key: sl. — slightly
def. — definitely
pron. — pronouncedly

Some graders are too lenient in dividing the cream into grades. The cream selected for each grade should be up to the full standard for that grade so that when the butter churned from it is graded by a federal butter grader, the grade of the butter will be up to the score for which the cream was selected.

Blending grades. In some small butter plants all the different grades of cream are put into one vat, processed and churned, usually with disappointing results. Cream of all grades blended together will generally result in the butter carrying the score of the lowest grade of cream mixed with the lot. Instead of getting about an average grade of all the qualities of cream mixed, the butter will generally be of the grade of the lowest grade cream.

Results obtained by Boyd and Nelson (1943) showed that only 15 percent of 89 score cream mixed with 85 percent of 93 score cream reduced all the resulting butter to 89 score. When cream scoring lower than 89 was blended with 93 score cream it required less than 15 percent of the lower scoring cream to reduce all the resulting butter to the lower score.

Blending cream so that all the resulting butter is reduced in score to that of the lowest grade cream not only is detrimental financially to the butter plant, but also is conducive to decreased consumption of butter.

Cream Quality Improvement

The amount of sour-cream butter made annually and the low grade of some of the butter made from old, sour, fermented cream clearly indicates the need for a definite cream-improvement program. Cream improvement, when explained to the producers, is generally in the abstract instead of a few simple practical rules which are easy to follow. Cream improvement has involved so many factors and the directions have gone into so much detail that the producer often gives up in despair before he starts. Instead of involving many details in a quality program it would appear that the basic fundamentals in producing quality cream be emphasized. These have been incorporated into a four-point program which should fit into the daily routine in the production of cream.

1. General farm sanitation. The improvement of cream starts on the farm. The cleanliness of the cow lots, cleanliness of the

cow barn, proper bedding to aid in keeping the cows clean, proper feeding routine and the absence of obnoxious weeds in the pasture or in the hay all favor the production of good, clean-flavored milk, which, when separated, will produce cream of comparable quality. The aesthetic appearance of the farm on which cream is produced should be such that it makes a good impression on the consumers of dairy products.

2. *Clean utensils.* Regardless of how much care is exercised in the production of milk, there are always some bacteria in it when it is drawn. The number of bacteria in fresh milk is low and the kinds of bacteria present in milk drawn from the udders of disease-free cows are harmless and rather inactive. The first real contamination of the milk takes place when it comes in contact with the first utensil and this contamination continues as it comes in contact with succeeding utensils used to handle it. The cleaner and the more sanitary the utensils, the less the milk is contaminated with the kinds of micro-organisms that may cause abnormal fermentations in it. When the milk is separated, many of the bacteria are concentrated in the cream. There are normally more bacteria in the cream than in the milk from which it was separated. If the milk is separated through an unwashed or a poorly washed separator the resulting cream will be so badly contaminated that the butter churned from it will not be of high quality.

3. *Prompt, adequate cooling.* The growth conditions for micro-organisms in warm cream are very good. To hold down the development of micro-organisms in the cream, each individual lot of cream should be cooled immediately after separation to the temperature of 45° F. (7.2° C.) or below, before it is added to the accumulated cream. The cream should not be frozen. The cream should be held at this low temperature until it is delivered to the plant. The rise in temperature during transit should be held to a minimum. In addition to checking the growth of micro-organisms in cream, which delays souring, the fine flavor qualities of the sweet cream are preserved at the low temperature.

4. *Frequent delivery.* Cream is supreme in quality immediately after it is separated and cooled. It will produce the best butter if churned while fresh. As the cream ages, the quality of the butter that can be made from it becomes lower and lower. The rate at which cream deteriorates in quality depends upon

the initial bacterial contamination and the temperature at which it is held. It is generally conceded that the more frequently cream is delivered to the plant the better the quality of the resulting butter.

Hence, by following the four simple practical prerequisites for cream quality improvement, namely, general farm sanitation, clean utensils, prompt adequate cooling, and frequent delivery the quality of the butter supply in the United States could be greatly improved.

Insanitary utensils, the separation of milk through an unwashed or poorly washed separator, improper cooling of cream and holding the cream too long on the farm before delivery to the plant are costing the dairy industry millions of dollars annually due to a lower market price received for the butter. Furthermore, the flavor of low-grade butter is not conducive to increased consumption.

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Review Questions

1. What is cream?
2. Name and define the different kinds of cream.
3. Why are table and whipping cream scored on the same score card as that used for scoring milk?
4. Why is the physical examination of cream important?
5. Explain why the percentage acidity in sweet cream is always less than the acidity of the milk from which it has been separated?
6. What is meant by "developed" acidity in cream?
7. What three things should be considered in judging the sediment in cream?
8. Describe the flavor qualities of good table cream.
9. Name the body defects of table cream.
10. By what method may the comparative viscosity of table cream be quickly obtained?
11. Name the flavor defects that may be found in table cream.
12. How may the sediment of cream be judged?

13. What precautions should be taken in making "feathering" tests of cream?
14. List the body defects of whipping cream.
15. Name the four qualities to be observed in studying the whipping properties of cream.
16. What precautions should be taken in making whipping tests of cream?
17. Name the body and texture defects of cultured cream.
18. How may frozen cream be sampled for tasting?
19. What precautions must be taken in sampling frozen cream for tasting?
20. What body defect may be expected in substandard cream?
21. What item should the judge observe especially in examining ready-whipped cream?
22. Describe the flavor of Devonshire cream.
23. What body and texture defects are particularly objectionable to Devonshire cream?
24. How is cream graded?
25. Of what importance is freshness and temperature in grading sweet cream?
26. How is cream for buttermaking graded?
27. List the defects that may be found in churning cream.
28. Give the flavor requirements of cream for making the different U. S. grades of butter.
29. What flavor defects in cream cause the resulting butter to be classed as "No grade"?
30. What is the percentage acid limitation for cream for each of the U. S. grades of butter?
31. Of what importance are age and temperature in grading cream for buttermaking?
32. Outline the cream grading routine.
33. Give the four main factors to be considered in the improvement of the quality of cream.

CHAPTER X

JUDGING FERMENTED MILKS

Judging or grading fermented milks to establish commercial market grades is never done. However, research workers in laboratories carrying out investigational work on cultures as well as laboratory technicians in dairy establishments manufacturing large quantities of cultured products have examined cultures and fermented products critically keeping in mind certain definite, desired qualities of the product. The desirable standards and the defects of the various fermented products will be discussed for each specific product.

The growth of selected bacteria at a desired temperature in a high quality whole or skimmilk which has been pasteurized to a high temperature or sterilized results in a thick, highly viscous, velvety-appearing coagulum known as a culture (starter). The first culture obtained after inoculation with the select organisms is known as a "mother" culture. Mother cultures are carefully carried from day to day and are used to inoculate whole or skimmilk to produce "commercial" or "cultured" buttermilk and to inoculate sweet cream to produce "commercial" or "cultured" sour cream. Cultures are also used to inoculate churning cream to improve the flavor of the resulting butter. Wide use is made of cultures in the cheese industry to develop the right kind and amount of acid in the various cheesemaking processes. Milk, whole or skim, or cream fermented by inoculating with a culture is known as "fermented or cultured milk" or as "cultured cream." Fermented milks play an important commercial role in the dairy industry.

Unfortunately, the systematic, routine judging of fermented milks has received very little attention. If practiced at all, the judging of fermented milks has involved largely the comparison of the products manufactured from day to day with those made previously. Such a procedure has its advantages, providing a definite mental standard of quality has been established. Too often it has resulted in the acceptance of a lower and lower

Table 26 — Summary of Score Cards for Cultures and Cultured Milk as Proposed by Different Workers

Author	Factors considered and scores allowed												
	Flavor			Body				Acidity	Appearance			Package	
	Flavor	Aroma	Flavor and aroma	Body	Viscosity	Body and viscosity	Body and texture		Appearance and color	General appearance	Visible dirt	Bottle and cap	Container
Burke (1926)	45				25				15		10	5	
Burke (1938)	35	15				25		15	10				
Hunziker *	40	20		20				20					
Mojonnier and Troy (1925)	45	15		15				15					10
Thom and Fisk (1925) **	50	20		10				20					
Totman, McKay and Larsen (1939) ***			60				30	5		5			

* Cited by Monrad and Hales (1935)
** The Cornell Score Card
*** The South Dakota Score Card

quality product until the consumer complained of its inferiority at which time corrections had to be made.

Score cards for fermented milks. A single score card for all fermented milks has not been formulated inasmuch as the products differ materially in their characteristics. On the other hand, one score card generally suffices for the judging of cultures (starters), cultured milk, and cultured cream. To date the American Dairy Science Association has not approved a specific score card for fermented milks. However, several have been suggested and used by different workers. Some of the proposed score cards and their authors are summarized in Table 26. In keeping with the general balance of items on the score cards for butter, cheese, milk and ice cream which have been approved by the American Dairy Science Association and with those previously summarized, the following score card for cultured milks is proposed:

The Cultures Milk Score Card

Factors	Perfect Score
Flavor	45
Body and Texture	30
Acidity	10
Appearance	10
Container and Closure	5
Total	100

This score card not only recognizes the importance of the items of flavor, body and texture in a good cultured milk, but also provides for the consideration of such other items as acidity, appearance, and container and closure. In using this score card in the judging of fermented milks, the same procedure should be followed as in the scoring of milk or cream which have been discussed fully in Chapters V and IX.

NATURAL BUTTERMILK

There are no specific quality standards for natural buttermilk inasmuch as the buttermilk varies according to the quality of cream from which it was obtained and according to the treatment, particularly acid standardization, which it has undergone.

Although there is an occasional demand for bottled natural buttermilk, it is not a popular item in the sale of milk products.

The source of supply in a market milk plant, which is equipped to bottle and distribute the product, is often uncertain and irregular. Furthermore, as pointed out by Finklestein (1917), its lack of uniformity in quality and its tendency to whey off and develop off-flavors has placed natural buttermilk in an unfavorable position in comparison to the cultured product.

Quality of natural buttermilk. The flavor and quality of natural buttermilk depends primarily upon the quality of cream from which it is produced, and, whether the cream was sweet or sour.

High-quality, *sweet-cream buttermilk* has a clean, sweet flavor not unlike good sweet cream. In comparison with that of cultured buttermilk, the body of natural sweet-cream buttermilk is relatively non-viscid, and pours smoothly like high-testing milk. It may or may not have flakes or granules of butter in it. When bottled and stored 24 hours, it should not exhibit any wheying-off.

High-quality, *sour-cream buttermilk* made from clean, sour cream which has been standardized for acidity has a slightly sour taste and a buttery aroma. The flavor is clean, pleasant and leaves no aftertaste. The body is slightly less viscid and smooth than that of sweet-cream buttermilk. It may or may not have flakes of butter present. No wheying-off should be exhibited in the bottled product after 24 hours storage at 40° F. (4.4° C.).

Both sweet- and sour-cream buttermilk are low in acidity in comparison to cultured buttermilk. Furthermore, they are generally somewhat dull in appearance.

Flavor defects of natural buttermilk. The flavor defects of natural buttermilk may be caused by: (a) off-flavors in the cream itself; (b) the results of improper standardization of acid in the cream; or (c) from churn contamination. The off-flavors caused by the cream are many and varied of which lack of freshness and high acid commonly predominate. Those resulting from improper standardization of acid in the cream are usually distinctive in that they are generally limy or bitter in character. The off-flavors associated with the churn are likely to suggest woodiness or mustiness. With a little practice, no difficulty should be encountered in identifying the off-flavor and tracing it to its source.

Body defects of natural buttermilk. Minor defects of the body of natural buttermilk — low viscosity and varying quantities of

butter granules and their uneven distribution — may be noted from time to time. The chief physical defect to which the product is susceptible is "wheying-off." This usually occurs at the top although it may appear in the middle or at the bottom of the bottle depending upon the amount of fat present and upon the contamination and growth of gas-producing organisms. Sometimes the defect is so serious that the product appears to have had water added to it. Natural buttermilk is generally smooth in texture and free from curdy particles which are sometimes associated with the cultured product. A butter-granule plug, a body defect similar to "cream plug" in table cream, resulting from the rising of the butter granules, is not uncommon in natural buttermilk.

Acidity of natural buttermilk. The percentage acidity of natural buttermilk will vary according to the acidity of the cream from which it was obtained. Buttermilk obtained from sweet cream will rarely exceed 0.25 percent acidity. Buttermilk resulting from the churning of sour cream or from ripened cream may sometimes approach the percentage acidity of cultured buttermilk, which is, from 0.70 to 0.85 percent. However, the acidity of natural buttermilk resulting from the churning of ripened cream which was previously standardized for acidity, is generally between 0.30 and 0.50 percent. Mojonnier and Troy (1925) give the titratable acidity of buttermilk from sweet cream as 0.22 percent and that from ripened cream as 0.70 percent. At the present time lower-acid cream is churned in order to get a higher pH in the serum of the resulting butter.

More important than the amount is the quality of the acid present. Undesirable acid fermentations in cream may result in the development of acids other than lactic which may impart undesirable flavors to the product. Regardless of the percentage acidity, the acid should impart a clean, pleasant, acid flavor to the buttermilk.

Appearance of natural buttermilk. Natural buttermilk, even under ideal conditions of production, often presents a dull, flat, grayish-yellow appearance. In case of wheying-off, the upper portion particularly appears watery. The frequent presence of butter granules which tend to rise to the surface gives to the buttermilk a decided lack of uniformity. The watery appearance and uneven distribution of the butter granules are most notice-

able after the product has been bottled and stored for some time. Occasionally, sediment may be seen in the bottom of the bottles of the stored product.

Container and closure. The container for natural buttermilk should present the same clean, neat, fresh appearance required of all packaged dairy products. Inasmuch as the viscosity of natural buttermilk is low as compared to the cultured product, difficulty is not encountered generally in completely filling the bottles due to air bubbles throughout the mass of the product. The closure of the bottle should meet the same requirements as for bottled market milk.

CULTURES

Unless a culture is of high quality, the quality of the final product resulting from the inoculation will be inferior. Consequently more attention should be paid to the judging of cultures.

Prerequisites to satisfactory judging of cultures involve a knowledge of the desired qualities of a culture pertaining to flavor, body and texture, acidity and general appearance, and also an appreciation of the technique of scoring cultures. The judging of cultures is so important that the judge should not rely solely upon the mental standard of quality for the product, but have available several samples for comparison so that the extremely small, though significant, differences in qualities may be detected.

Concerning the scoring of cultures, Monrad and Hales (1935) state:

> "Cultures and starters, in a strict interpretation of quality, do not have degrees of value. In other words, a starter having an off-flavor suggesting the smallest amount of contamination of foreign bacteria should be discarded. However, off-flavors such as those caused by over-heating milk and absorption of odors will disappear when the causative condition is removed. Likewise, the body of cultures and the larger starter may vary with the treatment and condition of the milk. If the operator is aware that even the slightest defect in the body is caused by bacterial, yeast or mold infection, the culture or starter in question should no longer be used.
>
> "Regular scoring of cultures or starters will acquaint the operator with the defects which result from contamination and from factors other than those caused by bac-

terial action. In view of these facts, inexperienced starter makers may find considerable value in the use of the score card.''

Flavor of Cultures

Cultures should have a pleasing, bouquet flavor resulting from the blend of a clean, delicate, somewhat aromatic odor and a pronounced though clean acid taste. The faint odor of diacetyl should be distinctly perceptible. Suggestions of foreign odors and tastes should not be present. Once the flavor characteristics of a good culture are fixed in mind they are not easily forgotten. The judge must always be alert to the possibility of the presence of one or more of the several off-flavors associated with cultures:

Barny. As its name suggests, the barny flavor suggests the odor of a cow barn. The off-taste is particularly noticeable in the after-taste following expectoration of the sample.

Bitter. A bitter flavor in cultures is generally detected toward the end of the tasting period and may be more pronounced after the sample has been expectorated. Such cultures may or may not have a normal amount of aroma. The aroma itself often suggests uncleanliness.

Cheesy. Cheesy flavor in cultures is very uncommon and is more often associated with cultures which have been held for some time. Its flavor characteristics, lack of good culture flavor and definite proteolytic and sometimes slightly bitter taste, are readily recognized.

Coarse. A coarse flavor culture lacks the delicate appeal and bouquet of a good culture. Such culture is often associated with a high titratable acidity resulting from over-ripening, and is low in volatile substance which goes to make up a desirable flavor and aroma.

Flat. The flat flavor is easily identified. It is characterized by a lack of odor and usually associated with a sharp-acid taste. Flat cultures have little or no flavor appeal. The flatness or lack of flavor is apparent soon after the culture is introduced to the mouth.

''**Green,**'' **undeveloped.** An undeveloped flavor, sometimes referred to as ''green'' has a slightly unclean odor, and a weak or mild acid taste, the combination producing a repulsive sensation. In many respects the flavor suggests that of milk which has begun to sour. This flavor is associated with a relatively low acidity.

High-acid. A high-acid flavor of cultures is very common. Its presence is easily detected by the resulting, slightly painful sensation on the tongue when the culture is taken into the mouth. This flavor is characterized also by a decided lack of pleasing aroma. Of the several off-flavors in cultures this defect is the most common and one of the easiest to detect.

Metallic. The metallic flavor in cultures is not common. The first impression is that the flavor is flat. However, as the culture is held in the mouth a sort of puckery, astringent, bitter flavor appears on the palate. If the defect is prevalent, the flavor remains on the palate after the sample is expectorated.

Yeasty. A yeasty flavor is usually characterized by a large volume of aroma faintly suggesting acetic acid associated with a quick, sharp-acid taste. The flavor is readily noted immediately upon bringing the culture to the sensory organs.

Miscellaneous. Other flavors than those described may be detected infrequently in cultures. Flavors such as feedy, foreign and rancid may be traceable to the milk from which the culture was made and may not be completely obscured by the flavors resulting from the growth of the culture organisms. Contamination also may result in the production of many and varied off-flavors which may not be specifically identified but may be readily recognized as not characteristic of a good culture. Off-flavors in culture milk may carry over into the culture.

Body and Texture of Cultures

The body and texture of a good, sufficiently ripened culture before being shaken should be firm, solid and uniform showing at the most not more than a few beads of whey exuded from its surface. The culture should break away cleanly from the side of the container upon tilting, revealing an intact, "livery" body somewhat like jello or custard. The body must not be so firm that it fails to break down to a creamy consistency upon shaking. The shaken product should stand up well when a teaspoonful is poured onto a smooth surface. The texture of the shaken culture should be smooth, resembling rich sweet cream. The culture should show no curd particles or lumps when it is spread out thin on a glass surface or when diluted with water. Some of the body and texture defects of cultures are as follows:

Curdy. A curdy texture lacks uniformity and smoothness. The curds may be sufficiently large as to be readily observed

upon pouring or so small that close observation is necessary to note the feathery curds.

Gassy. A gassy culture may be noted by the presence of gas bubbles or by streaks in the curd resulting from the rise of the gas bubbles to the surface. If accompanied by wheying-off, a gassy culture will likely whey off at the bottom or at the center.

Lumpy. A lumpy texture is often an aggravated curdy texture. Sometimes, however, the general texture of the culture is smooth with lumps of firm curd interspersed throughout. The defect is easily distinguished from the curdy texture.

Ropy. A ropy culture tends to string out when poured. Sometimes the defect is so pronounced that the culture strings out like a thin syrup.

Thin body. A thin body may be observed by tilting the unshaken culture to an angle of 45° whereupon the culture will often break and tend to flow. The shaken curd of such a culture will pour readily with a splash somewhat like water. The defect is usually accompanied by low acidity.

Wheyed off. This defect is manifest by a shrunken curd and the presence of free whey in areas around the side and on the surface, or under the cream layer when one is present.

Acidity of Cultures

The inclusion of the item of acidity as well as flavor on the culture score card seems somewhat redundant or tautological in that the same quality defect may appear in two different divisions of the score card. For example, if a culture were extremely high in acidity it would likely be criticized for having a sharp, acid flavor and be scored down accordingly; in addition, the culture would undoubtedly be scored down again because the titratable acidity would be too high. Despite this situation the inclusion of the item of acidity on the score card is suggested since the proper acidity is important in the development of the proper flavor and aroma in cultures.

Although it is generally recognized that the titratable acidity of a culture should be between 0.70 and 0.85 percent, the specific percentage is dependent upon many factors. Hammer (1938) states, "There is no definite acidity which is always the most desirable and some cultures must be ripened more than

others to develop the desired condition; with a given culture there also may be a variation from day to day.'' A close relationship exists between the acidity and the desired flavor. Hammer (1938) observed that, ''If a culture is insufficiently ripened it will lack flavor; if over-ripened the flavor will not be delicate but coarse.'' In view of the close relationship existing between acidity and flavor some defects of acidity nevertheless may be pointed out as follows:

High-acidity. This defect is probably the most common of the defects of acidity of cultures. It is easily recognized not only by the sharp, acid taste but by a high titration value as well.

Low-acidity. This defect is not so common. It is manifest by a titratable acidity below the lower limit necessary for good flavor and aroma development in cultures. Low-acid cultures usually have a ''green,'' undesirable flavor.

General appearance of cultures. A good culture has a glossy to a semi-glossy, velvety appearance (Figure 85). In reflected

Figure 85 — High Grade Butter Culture Showing the Desired Qualities of Appearance, Body, and Texture.

light the surface of the culture appears to have a sheen. Cultures having a chalky, dull, flat, lifeless, or watery appearance are undesirable. Cultures developed from whole milk may show slightly more yellow color than those developed from skimmed

milk. However, lack of a slight yellow color in cultures is not objectionable in the least.

Technique in scoring cultures. The scoring of cultures should be done in a systematic routine manner. The first step should be the examination of the unshaken culture. Notice the smoothness and solidity of the curd and its freedom from streaks, gas bubbles and whey. After these characteristics are observed, gently tilt the culture and note whether the culture remains intact or breaks easily.

After careful examination of the physical state of the curd, shake the bottle vigorously to render the curd smooth and creamy. Pour some of the culture into a glass beaker or other receptacle for tasting, noticing carefully meanwhile how the culture pours. Smell the poured cultures at once before the delicate aroma escapes; rotate the cultures in the beaker and smell again. Sniff particularly for the delicate buttery diacetyl aroma. After smelling the culture, take a teaspoonful or more into the mouth and taste it carefully. Get the very first impression as the sample is brought into contact with the sensory organs. Note how long that impression remains and whether it persists throughout the tasting period. Expectorate the sample, then note the after-taste. Following a few seconds of rest, repeat the tasting of the sample, not in an attempt to reproduce the taste sensation, but to note whether the second taste impression checks with the first one. Make a mental comparison of all the observed qualities of the culture judged with those of a desirable culture.

Precautions in judging cultures. In order that the judging of cultures may be done most accurately certain precautions of a preliminary nature should be observed. Hammer (1938) states:

> "In judging the flavors of cultures it is essential that the temperature be approximately uniform from day to day if accurate comparisons are to be made. Anyone accustomed to examining cultures at fairly low temperatures has difficulty in judging those that have not been cooled. When a culture is poured into a glass or cup it should be judged at once since free contact with air for only a few minutes may have a striking influence on flavor. There is a distinct advantage in having a number of cultures to compare and they should differ in quality. When only one culture is examined day after day it is difficult to recognize small but significant defects, and often the cul-

ture is considered to be better than comparison would show it to be.''

CULTURED OR COMMERCIAL BUTTERMILK

Cultured buttermilk is the product resulting from the ripening of heat-treated skimmed or whole milk properly cooled and bottled. In many respects its qualities compare favorably with those of cultures which have been previously described. However, various trade demands have resulted in the establishment of certain properties in cultured buttermilk which are somewhat different from those of cultures.

The importance of grading or judging cultured buttermilk as a part of the routine procedure in a milk plant cannot be overestimated. The quality of the product is dependent upon so many factors that it cannot be taken for granted. Furthermore, the quality of the buttermilk is often the customer's criterion of the quality of the other dairy products sold by the plant.

Flavor of Cultured Buttermilk

In general, the good, clean, pleasant, diacetyl flavor of a culture is desired in cultured milk. This flavor may be enhanced or enriched by the presence of butterfat, added as cream or supplied by the whole or partially-skimmed milk from which it was made. The flavor defects of cultured buttermilk are quite similar to those of cultures. However, it should be emphasized that the flavor defects associated with high acidity are probably the most common of cultured buttermilks.

Body and Texture

The demands of the trade vary as to the body of cultured buttermilk. Some customers prefer a heavy, viscid body; others insist upon a thin body. Consequently, no definite standard for body of cultured buttermilk may be established that would be agreeable to all. However, a medium-bodied, cultured buttermilk, pouring similar to a thin gravy, seems to be most in demand.

Although the body and texture defects of cultured buttermilk are quite similar to those of cultures, some of them need further explanation in the light of a desirable commercial product. Some of the more pronounced body and texture defects of cultured buttermilk are as follows:

Curdy texture. A curdy-texture buttermilk appears to have a rough, coarse body (Figure 86) which is particularly notice-

able as the buttermilk recedes from the glass or is poured slowly over the lip of the bottle. The individual curds may be quite small, even smaller than a pin head and some may be as large as a grain of wheat. By diluting a sample of the buttermilk in a

Figure 86 — Curdy Cultured Buttermilk.

glass container with a high proportion of cold water, the individual curds will settle to the bottom where they may be readily seen upon pouring off the liquid. Usually a curdy buttermilk is associated with a thin, weak body and often with wheying-off.

Heavy body. A heavy-bodied, high-viscosity cultured buttermilk is generally not preferred by the trade. Such buttermilk not only pours from the bottle with difficulty but is also difficult to drink. Sometimes the condition is so serious that the poured product appears to stand up somewhat like whipped cream. The defect may be associated with entrapped air, with short-filled bottles and with wheying-off.

Thin body. A thin-bodied, low-viscosity buttermilk is easily recognized upon pouring during which it breaks, drips and splashes very much like water. Frequently the body defect is

associated with a dull, dead lustreless appearance. Furthermore. the body defect may be associated with a flat taste and a lack of aroma; or a weak body very subject to wheying-off.

Wheying-off. This troublesome defect, as in cultures, manifests itself by the presence of free whey usually at the surface (Figure 87) but sometimes at the bottom or middle of the container. Should wheying-off occur other than at the surface in skim-milk buttermilk, the defect is likely associated with the presence of entrapped air or gas resulting from abnormal fermentation. Such wheying-off in this buttermilk is the exception rather than the rule. Wheying-off of creamed, whole milk, or partially skimmed-milk buttermilk at the center or bottom may be expected as the presence of fat in the curd may increase the buoyancy of the curd. In this case the wheying-off may not be associated with presence of gas.

Figure 87 — Wheyed-off Cultured Buttermilk.

General Appearance and Color

The general appearance and color of cultured buttermilk should be pleasing, attractive and uniform whether the product is made from skimmed or from whole milk. The desired color is a luster white or a white tinged with yellow resulting from the presence of the natural color of the butterfat of the milk used or the cream added. Pronounced or off-shade colors are definitely discriminated against in most markets. By placing a bottle of the off-color buttermilk alongside a bottle of whole milk its color may be compared and judged very reliably.

Acidity

The acidity of cultured buttermilk often shows a wider range than does that of cultures. The higher acidity probably results from: (a) failure to cool the vat of buttermilk promptly when it

is sufficiently ripened; (b) to inadequate cooling; and (c) to prolonged storage after bottling. The lower acidity may often be accounted for by the dilution of the ripened product with sweet skimmed milk, whole milk or cream added primarily for the purpose of lowering the viscosity. A low-acid buttermilk, that is one having less than 0.70 percent titratable acidity, is not scored down heavily. On the other hand, cultured buttermilk having a titratable acidity above 0.85 percent is criticized severely. In scoring the acidity of buttermilk, care must be exercised that heavy, double deductions are not made, one on the flavor and one on the acidity.

Container and Closure

The container and closure for cultured buttermilk is scored exactly as that for market milk. The defects encountered will in general be the same as those noted in the routine scoring of market milk. One defect, however, that of "short-" or "slack-fill," is more frequently noted in judging cultured buttermilk than in judging market milk.

Procedure in Scoring Cultured Buttermilk

The technique and procedure followed in scoring cultured buttermilk is the same as that in the scoring of cultures. The importance of having several samples available for scoring cannot be over-emphasized. These may be had by setting aside several bottles from each batch of buttermilk. In this way a number of samples of several stages of freshness may be had for scoring. A variety of samples may also be purchased from stores or other dairies. The best scoring of the samples is done when the identity of the samples is not known. Accordingly, after the container has been scored, an adequate portion of the sample should be transferred to another bottle which has been properly marked for identification. The labeling should be done by someone other than the judge. By so obscuring the identity of all the samples real progress can be made in selecting the most desirable cultured buttermilk.

FLAKE OR GRANULED BUTTERMILK

Cultured buttermilk containing butter granules is a fermented milk product in great demand in some localities. The butter granules are present as a result of: (a) the addition of melted butter; (b) the addition of separately-churned, butter granules;

(c) churning all or a portion of the creamed buttermilk; or (d) circulating the entire lot of creamed buttermilk through a specially designed pump. This product has some qualities differing from those of the product from which it is made.

Flavor

The flavor of flake buttermilk should be clean, rich and have the diacetyl flavor of fresh butter. If the butter or cream is of high quality and the equipment is sanitary, the presence of butter granules does not impair, but rather enhances, the buttery flavor of the product. Some of the flavor defects of cultures and cultured buttermilk are also found in flake buttermilk. In addition, flake buttermilk may have some flavor defects which because of the absence of the granules are not present in cultures and cultured buttermilk. These are:

Lack of buttery flavor. While the flavor of the flake buttermilk might be all that could be desired of a high-quality cultured buttermilk, the product is discriminated against if it does not have at least a trace of the buttery flavor. The presence of the granules suggests a high, full butter flavor. If this flavor is not present the product seems particularly flat.

Poor blend of flavor. This defect is present when the serum appears to yield one flavor and the butter granules another. Both flavors may be satisfactory but the blend is poor or lacking. Such buttermilk may not have been aged sufficiently long to secure a good blend. The defect may be associated with large butter granules.

Body and Texture

The body and texture of flake buttermilk should be similar to that of cultured buttermilk. As a general rule the body is slightly heavier than that of cultured buttermilk, but not as heavy as that of cultures. The body should be sufficiently viscous to stabilize the butter granules. Two defects are sometimes noted in the body and texture of flake buttermilk:

Butter-granule plug. If the body of flake buttermilk is weak and the granules are large the combination may result in the formation of a butter-granule plug which is very objectionable (Figure 88).

Uneven body. The upper portion of the bottled product showing this defect is quite viscous whereas the lower portion is very

lacking in viscosity. This defect is closely associated with uneven distribution of the butter granules.

General Appearance

Two qualities are desired in the general appearance of flake buttermilk, namely, uniform distribution of butter granules and

Figure 88 — Granuled or Flake Buttermilk Should Have a Stable Suspension of Evenly Distributed, Richly-colored Butter Granules (Left). Distribution and Stability of the Butter Granules Are Poor in the Bottles at Center and Right.

a high, golden-yellow color of the granules against a white background. The defects encountered in the general appearance of flake buttermilk are:

Lack of color. Sometimes the granules are not sufficiently colored and when the container is observed at a distance of a few feet, the granuled buttermilk looks like plain cultured milk. While this defect does not seem so serious as the defect involving unnaturally-colored or highly-colored granules, nevertheless this bleached-like color does merit criticism. The color of the butter granules should be of a "June" butter-color shade. To make this shade uniform, the fat in the granules added should be colored at seasons of the year when this shade is not naturally produced.

Lack of uniformity. In such cases the highly-colored granules may not be evenly dispersed or may be so uneven in size that the buttermilk appears spotty.

Unnatural color of granules. The "June" yellow-color butter granules should stand out against the white background. To accomplish this effect, the granules are more highly colored than would be desirable for butter. Sometimes the coloring is not well blended with the granules, thus causing a reddish-yellow-appearing granule which is very objectionable.

MISCELLANEOUS FERMENTED MILKS

In addition to the fermented milks previously discussed, others having a more or less minor significance should be considered. Two in particular, Bulgarian buttermilk and acidophilus milk, have qualities which are quite specific for each. Although these fermented milks are not of real commercial significance and are never judged commercially, they have certain desirable qualities which should be checked occasionally.

Bulgarian Buttermilk

This product is the result of growing a pure culture of *L. bulgaricus* in highly-heated or sterile skim or whole milk at a comparatively high temperature (90° F. to 110° F.) (32.2° C. to 43.3° C.). The finished product is comparatively high in acid, ranging from 1.5 to 3.0 percent. The body is generally heavy, thick, viscous and gelatinous in character and is accompanied by a glossy, velvety appearance. Bulgarian buttermilk has a distinctly sharp, puckery, acid taste somewhat resembling that of unsweetened rhubarb juice. The aroma is coarse and acidy not resembling the pleasing aroma which is a normal characteristic of cultured buttermilk. Bulgarian buttermilk is subject to many flavor defects due to the high heating requirement of the culture milk and the high growth temperature of the organisms. If the milk contains any viable organisms or spores when it is inoculated, off-flavors may develop due to the *L. bulgaricus* organisms being outgrown by the foreign organisms.

Too high acid may result in some cases which will give the product an unpleasant flavor and a puckery sensation on the palate.

Some *L. bulgaricus* cultures have a tendency to develop a ropy body. These ropy cultures may or may not have an off-flavor.

Acidophilus Milk

Highly pasteurized or sterilized whole or skimmilk fermented by *L. acidophilus* is sold under the name of acidophilus milk.

The optimum growth temperature for *L. acidophilus* is between 95° F. and 100° F. (35° C. to 37.8° C.). The organisms develop comparatively slowly even at the right temperature which allows any viable organisms or spores in the culture milk to outgrow the culture organisms which will result in an off-flavor. Due to high heat treatment of the culture milk, acidophilus milk usually has a distinctive, light-brown, caramel-like color which is not objectionable as it indicates proper preparation of the culture milk.

The flavor of acidophilus milk is distinctive also, being a blend of the caramel-like flavor, resulting from the heat treatment, with the sharp, acid taste resulting from the presence of 1.0 to 1.5 percent acid.

The body, if normal, should be similar to that of cultured buttermilk. Wheying-off is the main body defect encountered in this product.

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Review Questions

1. Give the proposed score card for cultured milk.
2. What has been the average value assigned to flavor on the culture score cards previously used?
3. Why is bottled natural buttermilk not an important commercial product?
4. What is the chief defect of natural buttermilk?
5. Describe the flavor of a desirable culture.
6. List the common flavor defects of cultures.
7. Describe the body and texture of a good culture.

8. List the body and texture defects of cultures.
9. Name some precautions in judging cultures.
10. Compare the general qualities of cultures and cultured buttermilk.
11. What is the chief body and texture defect of cultured buttermilk?
12. With what defect is a butter-granule plug in flaked buttermilk usually associated?
13. What appearance defects are associated with flake buttermilk?
14. Compare the titratable acidity of cultured buttermilk and Bulgarian buttermilk.
15. Outline the procedure to follow in judging fermented milks.

CHAPTER XI

JUDGING EVAPORATED AND CONDENSED MILK

Critical quality comparison of evaporated and of condensed milk is a relatively new field for the dairy products judge as well as for the manufacturer of these products. Although the dairy products judge and the concentrated milk manufacturer have always been alert to possible defects in concentrated milks, they have not been as critical of the product as they have been with other dairy products such as milk, butter, cheese, and ice cream. On the other hand, technicians, laboratory control officials and research workers have been familiar with the qualities of concentrated milk products for some time. Routine examination of these products was made chiefly as a means of improving the product or that the products might reach the consumer in good condition. Certain quality and definition standards for these products have been established with which the judge should be familiar.

Classes of Concentrated Milk

Several distinct classes of concentrated milk are on the market. Most of these classes of concentrated products have specific characteristics and qualities peculiar to themselves. The identities of the various types of concentrated milks are as follows:

Evaporated milk. Evaporated milk is fresh whole milk concentrated under a vacuum at the ratio of 2:1 to 3:1, canned and sterilized. It is distinguished from other liquid concentrated milk in that it reaches the market in sealed cans, is sterilized by heat and is unsweetened.

The Federal standard of identity for evaporated milk under the Food, Drug and Cosmetic Act is, in part, as follows:

> "*Evaporated milk — Identity-Label statement of optional ingredients.* (a) Evaporated milk is the liquid food made by evaporating sweet milk to such point that it contains not less than 7.9 percent of milk fat and not less than 25.9 percent of total milk solids. It may contain one or both of the following optional ingredients:

(1) Disodium phosphate or sodium citrate or both, or calcium chloride, added in a total quantity of not more than 0.1 percent by weight of the finished evaporated milk.

(2) Vitamin D in such quantity as increases the total vitamin D content to not less than 7.5 U.S.P. units per avoirdupois ounce of finished evaporated milk.

It may be homogenized. It is sealed in a container and so processed by heat as to prevent spoilage."

Sweetened condensed milk. Sweetened condensed milk, also known as "condensed milk," likewise is concentrated under vacuum at about the same ratio as evaporated milk, but differs from that product in that it contains about 40 to 45 percent added sugar for preservation. The Federal standard of identity for this product is as follows:

"*Sweetened condensed milk — Identity.* (a) Sweetened condensed milk is the liquid or semi-liquid food made by evaporating a mixture of sweet milk and refined sugar (sucrose) or any combination of refined sugar (sucrose) and refined corn sugar (dextrose) to such point that contains not less than 28.0 percent of total milk solids and not less than 8.5 percent of milk fat. The quantity of refined sugar (sucrose) or combination of such sugar and refined corn sugar (dextrose) used is sufficient to prevent spoilage."

Plain condensed milk. Plain condensed milk, sometimes called "concentrated milk," is equivalent to evaporated milk except that it has not been sterilized and is marketed in bulk.

Plain condensed skimmilk. Plain, condensed skimmilk is skimmilk concentrated at the ratio of 3:1 to 4:1 and is generally used in ice cream or in the baking industry. The product is not sterile and usually reaches the market in bulk. Most frequently the product is superheated, to increase its viscosity.

Bottled concentrated milk. This product is essentially plain condensed milk, concentrated at the ratio of 2:1 primarily for bottling and distribution similarly to market milk. The product is not sterile. When diluted with equal parts of water the original volume of whole milk is obtained. Sometimes this product is called "Duo-rich" milk.

EVAPORATED MILK

When judging or grading evaporated milk the judge must keep in mind the desirable qualities and standard for the product. He must be aware that, in addition to meeting the legal

chemical requirements for the product, *high quality evaporated milk must be creamy in color, have a relatively viscous body, be uniformly smooth in texture, and possess a mild, pleasant flavor.* Furthermore, the container should present an attractive appearance having a neat, well applied label with the ends of the can polished and showing no bulges or dents. The judge should be familiar also with the characteristics of the various defects which may occur in evaporated milk. These defects will be discussed later in considerable detail.

Score Card for Evaporated Milk

The score cards suggested for evaporated milk give an idea of the relative value of the various items considered in judging evaporated milk. No score card for evaporated milk has been officially adopted. The score card for evaporated milk tentatively suggested by the committee on legal standards and score cards for dairy products of the American Dairy Science Association (1922) with suggestions for its use is as follows:

Properties	Perfect Score Percent
Flavor and odor	40
Body and texture	35
Color	5
Fat content	10
Total solids	10
Adulterants and preservatives must be absent	
Total score	100

"Flavor and odor. Perfect: Must be fresh, sweet and free from off-flavors. Deduct 1 to 10 points if metallic, rancid and stale. Deduct 40 points if sour, bitter, putrid, gassy or otherwise fermented.

"Body and texture. Perfect: Must be creamy, of uniform emulsion, smooth. Deduct 1 to 10 points each for curdy milk, separated or churned milk.

"Color. Perfect: Must be creamy. Deduct 1 to 3 points if brown.

"Fat content. Perfect: Must contain not less than 9 percent milk fat. Deduct one point for each one-half percent less than 9 percent. Deduct 10 points if less than 7.8 percent, the present Federal Standard.*

"Total solids. Perfect: Must contain not less than 28 percent solids. Deduct 1 point for each 1 percent or frac-

*See footnote Page 363.

tion thereof, less than 28 percent. Deduct 10 points if below 25.5 percent, present Federal Standard.*

"Adulterants and preservatives. Perfect: Must be free from all adulterants or preservatives. If it contains animal or vegetable fats, or other ingredients foreign to the composition of normal milk, or any preservatives deduct 100 percent."

Later (1923) the committee recommended that the score card for condensed and evaporated milk be changed by having the points allowed for body and texture and bacteria count increased and the points allowed for fat and flavor decreased.

Mojonnier and Troy (1925) suggested the following score card for evaporated milk.

Item	Perfect score	Remarks
Viscosity	15	Good viscosity, but not enough to flake in water or coffee. Sufficient to convey correct impression of its value.
Homogeneity	15	No fat separated. No specks or lumps. Product smooth and homogeneous throughout.
Color	5	Medium color like heavy cream. Neither too white nor too dark. Sufficient color to insure safe sterilization.
Flavor	30	Rich, nutty flavor. Cooked taste not too pronounced. No foreign flavors.
Odor	2	No appreciable odors of any kind.
Sediment	3	No lumps or coagulated casein. No foreign matter. No precipitate of calcium citrate.
Appearance container	5	Neat labels properly applied. Ends of cans well polished, and not bulged.
Fat	10	No foreign fats. No preservatives. Fat content to conform to legal requirements.
Total solids	10	Total solids content to be not under legal requirements.
Net weight	5	Net weight to be not under amount specified upon the label.
	100	

* These standards have since been changed. See standards at the beginning of this chapter.

Procedure of Examination

A routine in examining cans of evaporated milk facilitates judging of the samples. The following steps have been found to be of material aid in going over a lot of samples.

1. *Avoid undue agitation* when transporting the cans to the laboratory. Carry them in an upright position placing them on the table, in the same upright position so as to avoid remixing any occurring deposits or fat layers in the milk.

2. *Examine the can for appearance.* This may be done without lifting the can from the table. Notice the upper end of the can for polish. Observe the neatness of the label and the evenness of its application. Insert a knife under the label cutting it from top to bottom, remove partially, or throw back the label and notice the condition of the can with respect to freedom from rust spots.

3. *Open the can in such a way* that both the can and contents may be examined. With an edge-cutting can opener cut practically around the entire periphery of the upper end and turn back the lid as shown in Figure 89.

Figure 89 — Fat Separation in Evaporated Milk (*Gould*).

4. *Examine the evaporated milk for appearance.*

a. Color. Notice the color of the milk. The milk should reveal a light, uniform cream color but may tend

toward a brown color in which case the exact shade of color may be determined by comparing it with color standards or by recording the relative intensity of brown as follows:

—, no browning
+, slightly brown
++, distinctly brown
+++, pronouncedly brown

b. Uniformity. The milk should be uniform as shown by the absence of a cream layer, curd, or butter particles. Uniformity may be determined in part by means of a spatula (Figure 89). The result of the examination for uniformity of the product may be verified later when the product is examined for body and texture. In the macroscopic examination of the product for uniformity, the judge should notice particularly the under surface of the turned-back lid for adhered cream or deposited salts.

5. Study the body and texture. Pour the contents of the can slowly into a clean glass beaker, noting meanwhile how the milk pours. The body and texture of evaporated milk may be noted in part as the entire contents of the can is poured into the beaker. Smooth, relatively viscous evaporated milk pours like a thin cream without marked splashing. Allow the can to drain well. After emptying the container look for any deposit which may be present in the bottom of the can. If the metal surface of the bottom cannot be seen through the film of evaporated milk remaining, scrape the bottom with a spatula to see if a firm deposit is present. Set the can aside for further examination later and proceed with the examination of the poured evaporated milk for viscosity and texture. With a black plastic or hard rubber spatula "spoon up" some of the milk and allow it to drip back into the beaker. Notice the relative thickness and uniformity of the film remaining on the spatula. A further test to show the "grain" of evaporated milk is by examining a film of the milk through which light has been transmitted. By means of a ½- to ¾-inch wire loop or a cut-away spoon observe a film of the milk for evenness throughout. This may be done by dipping the loop into the product and withdrawing it carefully to leave a film across the loop. Hold the film to the light and look for pin-point curd particles. If the milk

appears rough, grainy or lacks uniformity, this condition may be associated with excessive viscosity or "feathering" in coffee.

If the milk lacks uniformity, determine, if possible, the nature of the cause. Try to determine whether the chief contributing factor is the fat, the protein, the salts or foreign material. If the fat is chiefly responsible, the defect will appear at the top of the can as a cream layer or as buttery particles. If protein is the chief contributing agent, then the defect will appear as various size curds distributed throughout. If the salts are responsible, a hard gritty precipitate may have formed in the bottom of the can. If foreign material is the cause a sediment may be evident in the bottom of the can, as a smudgy discoloration when the last of the milk is poured out.

6. Observe the condition of the container. Look especially for spangling and rusting of the container. Rinse out the container and observe the inner surfaces. The surface should appear even throughout and show no evidence of chemical activity. Spangling appears as clean, bright, dark, overlapping blotches on the surface as though the tin were attacked by acids. Usually these blotches are fairly well distributed but sometimes, like discoloration and rusting, may be noted particularly at the milk-air surface line. However, spangling alone will manifest itself generally below this point. Rusting may be noted especially when present above the milk line.

7. Determine the color reaction in coffee. Evaporated milk should impart to coffee a rich, golden brown color. The coloring power of the evaporated milk may be determined readily by adding approximately 10 ml. of the milk to 100 ml. of the coffee. A greenish-dark, muddy, slate discoloration resulting from the above mixture indicates the presence of iron contamination (Gould, 1944, and Cole and Tarassuk, 1944). Thus, the off-color in the evaporated milk-coffee mixture may be associated with rust formation in the container.

8. Note the miscibility with coffee. According to Whitaker (1931) feathering in hot coffee is not a common defect of evaporated milk as manufactured today. Nevertheless, the product may well be examined for this possible defect at the same time the evaporated milk is being examined for its coffee-coloring ability. The defect appears as finely divided, serrated curds

shortly after the evaporated milk has been added slowly to the hot coffee.

9. Determine the flavor. Dilute the evaporated milk half-and-half with distilled water. Sample and judge, using the same procedure as in judging bottled milk. Keep in mind that high-quality evaporated milk has a specific, mild cream flavor somewhat like that of delicate, high quality mushroom soup.

Defects in Evaporated Milk

Flavor. The flavor defects which may occur in evaporated milk are usually unlike those commonly occurring in bottled fresh milk. This is due to the concentration of the milk under vacuum which removes volatile off-flavors and is also due to the product being preserved by heat sterilization.

Theoretically, the flavor changes occurring in evaporated milk should be largely the result of chemical, rather than of bacteriological decomposition. However, several references are to be found in the literature in which the causative agent of the off-flavor was bacterial. Hammer (1917) noted a fishy flavor in evaporated milk. These flavor defects arising from bacterial growth, while serious in themselves because they result in spoilage and decreased sales of the product, are rather uncommon.

Probably the most common flavor defect in evaporated milk is that which seems to be associated with progressive age-darkening or browning of the product. No one term seems to describe the off-flavor adequately. Such terms as slightly acid, stale-coffee, old, sour, and strong suggest the nature of the defect. The term caramel, suggested probably by the brownish color of the milk, is not very descriptive in this case. The caramel flavor connotes a pleasant, appetizing taste sensation which is definitely lacking in the defect associated with age-darkening of evaporated milk. This flavor defect is easily detected. When the sample is first taken into the mouth the flavor sensation is not particularly different from that of normal evaporated milk, but soon the delayed, slightly-acid taste reaction occurs. This taste is persistent even after the sample has been expectorated for some time. The off-flavor is accompanied by only a slight odor suggesting staleness. It is not surprising that the underlying taste reaction of the age-darkened evaporated milk is acid. Mojonnier and Troy (1925) showed an increase in titratable acidity in evaporated milk with age particularly when the

product was held at relatively high storage temperatures, which temperatures were also favorable to darkening of the color. The percentage titratable acidity in evaporated milk under various temperatures and periods of storage are presented in Table 27.

Table 27 — Titratable Acidity in Evaporated Milk at Various Stages (Mojonnier and Troy, 1925)

Name and treatment of product	Titratable acidity (percent)
Fresh milk	
Before heating	0.14
After heating	0.13
Evaporated milk	
Before sterilizing	0.32
After sterilizing	0.39
After 4 months at 45° F.	0.39
After 4 months at 68° F.	0.40
After 4 months at 85° F.	0.43
After 1 year at room temperature	0.45
After 2 years at room temperature	0.50
After 3 years at room temperature	0.55

Body and texture. The manufacture of evaporated milk is subject to such laboratory control today that marked uniformity exists in the product not only within the plant but also among evaporated milks from different plants. Fresh evaporated milk is remarkably free of body and texture defects. However, when evaporated milk is held for a long period of time or under adverse conditions some body and texture defects may be encountered. The defects in the body and texture of evaporated milk which may sometimes be encountered are as follows:

1. Buttery
2. Curdy
3. Feathering
4. Gassy
5. Grainy
6. Low viscosity
7. Sediment

1. Buttery. The buttery defect appears as a ¼- to ½-inch layer of heavy cream at the top of the can (Figure 89). Frequently, the cream layer is so dense and tenacious that it is miscible with the remainder of the milk only with difficulty. Under such conditions the shaken milk appears curdy having floating masses of creamy or buttery chunks in liquid of relatively low

viscosity. There are several alleged causes of this defect. Among them are inadequate homogenization, high storage temperature, long storage period and improper handling while in storage. The defect is a serious one to the consumer as such milk fails to pour readily, thus creating a suspicion that the milk has spoiled. The defect is not associated with any particular flavor defect.

2. *Curdy.* Curdy evaporated milk may be noted by the presence of many coagulated particles interspersed throughout the milk or by a continuous mass of coagulum. This condition differs from the buttery defect in that it is associated chiefly with the protein rather than the fat. Curdy evaporated milk may be accompanied by an off-flavor such as that accompanying "flat-sours." The defect is rare, but when occurring it is serious.

3. *Feathering.* The feathering of evaporated milk in hot coffee cannot be foretold by macroscopic examination but by actually testing the milk under examination in hot coffee. Such a test has been proposed by Whitaker (1931). He found upon examination of 52 cans of commercial evaporated milk, however, that feathering in hot coffee was not a common defect of the modern product. Mojonnier and Troy (1925) found that the formation of curd when evaporated milk was added to coffee was due entirely to an excess of viscosity.

4. *Gassy.* Gassy evaporated milk is rather uncommon. The defect is manifest by bulged cans and sometimes by a hissing sound of escaping air when the can is punctured. When a sufficient volume of gas is produced to distend the ends of the can the flavor is impaired.

5. *Grainy.* A grainy evaporated milk is one lacking smoothness and uniformity throughout. Such milk seems coarse (Figure 90). A film across a loop or an open-bottom spoon will transmit light unevenly if the defect is present. Grainy evaporated milk is often associated with an excessively heavy, viscid body. The judge must bear in mind that grainy evaporated milk does not actually contain "grains" of sediment such as are often found settled out in the container. Neither does such milk contain curds or lumps of butter. However, the presence of pin-point size curd particles may be noted when light is transmitted through a film of the product.

6. *Low viscosity.* A low viscosity evaporated milk may be noted by its milk-like consistency. Such milk lacks creaminess and pours from the container as readily as if it were fresh milk. This defect is discriminated against as it connotes inadequate condensation.

7. *Sediment.* Sedimentation in evaporated milk may be of two kinds which arise from entirely different sources. The sedi-

Figure 90 — Grainy Evaporated Milk. Also Showing Mineral Deposit on the (open) Bottom of the Container (*Gould*).

ment resulting from settling of leucocytes, disintegrated cells, denatured protein and foreign material of more or less of a colloidal nature is usually darker in color than the evaporated milk. Since this sediment is readily miscible it may be seen only when a can, undisturbed for some time, is emptied slowly. This defect, rarely present, is not noted by the consumer, largely because the milk is subject to some agitation especially when the milk is poured out through small punctures in the can.

The other type of sediment sometimes noted in evaporated milk is the result of the crystallization of some of the calcium and magnesium salts (Sato 1923a) as tri-calcium phosphate $Ca_3(PO_4)_2$, magnesium phosphate $Mg_3(PO_4)_2$ and tri-calcium citrate $Ca_3(C_6H_5O_7)_2$. This defect accompanies aging of the evaporated milk. The rapidity with which the crystals form seems to be influenced by the nature of the milk, conditions of manufacture and the temperature of storage. Mojonnier and Troy (1925) and Gould and Leininger (1947) found these white,

gritty, sand-like particles to be chiefly lime salts of citric acid or tri-calcium citrate, $Ca_3(C_6H_5O_7)_2 \cdot 4H_2O$ (Figure 91). Their bland, chalky taste suggests a calcium salt of some kind. These crystals vary from the size of a pin-point to the size of a kernel of wheat. They are found in the bottom of the container where they may be noted especially when the contents are emptied. The

Figure 91 — Crystals Obtained From a Can of Evaporated Milk.

presence of these crystals in evaporated milk is not in keeping with the highest quality product.

Color. In judging evaporated milk two possible color defects may be encountered. These are (1) too light in color and (2) too dark in color. The latter is commonly referred to as darkened, discolored or brown.

1. Too light color. This defect is not serious although the light color is definitely not desired. The defect is manifest by a lack of creamy color suggesting to the consumer a lack of fat which is not the case. During some months of the year milk produced in certain sections may be lacking in the pigments which give fat its natural color. Therefore, a light color may be expected at times.

2. Brown. The brown discoloration in evaporated milk associated with high sterilization temperature, high storage temperature and age is a serious defect in evaporated milk, the seriousness depending upon the extent of darkening. Evaporated milk is discriminated against when it shows an indication of browning which obscures the ideal creamy color (Figure 92) Webb and Holm (1930) studied the color of evaporated milk

using the Munsell color system by which the attributes of color, namely, brilliance, chroma and hue, were determined quantitively. Using $CaCo_3$ as a base with $FeCl_3$ and $K_2Cr_2O_7$ to impart color they established permanent standards for judging the color of evaporated milk. These investigators observed that the darkening of the color due to the temperature of storage

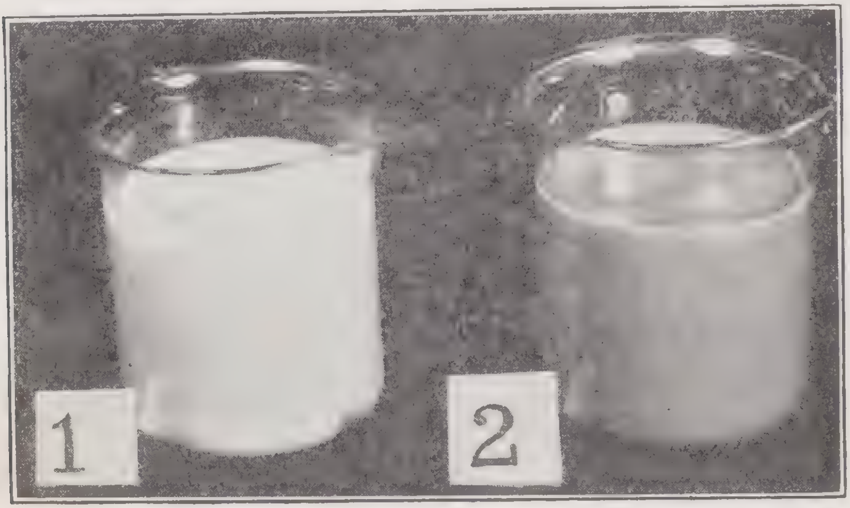

Figure 92 — Normal (1) and Browned (2) Evaporated Milk (*Gould*).

gave the milk a yellowish-green color unlike that resulting from the temperature and time of sterilization. This indicated that factors other than caramelization of the lactose affect the color of the stored milk.

SWEETENED CONDENSED MILK

Since sweetened condensed milk contains a sufficiently high percentage of sugar for its preservation, the flavor is pronouncedly and predominately sweet. Beyond this intense sweetness, however, the flavor of the dairy product should be clean and pleasant with a slight trace of mild caramel as an aftertaste. The body should be smooth and uniform and the color a light, translucent yellow. The judge should be familiar with the desirable qualities of the product as well as the possible defects and the frequency of their occurrence.

Score card for sweetened condensed milk. The score card for sweetened condensed milk tentatively suggested by the committee on legal standards and score cards for dairy products of the American Dairy Science Association (1922) with suggestions for its use is as follows:

Properties	Perfect Score Percent
Flavor and odor	30
Body and texture	25
Color	5
Fat content	10
Milk solids	10
Bacteria	10
Sugar	10
Adulterants and preservatives (must be absent)	——
Total score	100

Suggestions for Use of Score Card

"Flavor and odor. Perfect: must be fresh, sweet and free from flavors. Deduct one to ten points each if metallic, rancid, stale, cheesy. Deduct one to thirty points if sour, yeasty or otherwise fermented.

"**Body and texture.** Perfect: Must be viscous, smooth and free from lumps of curd, sugar, sediment and foreign impurities. Deduct one to five points if rough and sandy, from one to five points if sugar sediment in bottom, from one to five points if fat separation, one to five points if white and yellow buttons, 15 to 25 points if lumps of curd.

"**Color.** Perfect: Rich cream to yellow. Deduct one to five points if brown.

"**Fat content.** Perfect: Must contain not less than 10 percent milk fat. Deduct one point for each half percent less than 10 percent. If below 8 percent deduct ten points. Deduct 10 points if below 8 percent present Federal Standard.*

"**Total milk solids.** Perfect: Must contain not less than 32 percent.* Deduct one point for each percent or fraction thereof below 32 percent. If below 28 percent deduct ten points.

"**Sugar.** Perfect: The concentration shall be from 60 to 62 percent. Deduct two points for each percent concentration below 60 or above 62 percent. The concentration shall be determined by dividing percent of sugar by the sum of percent of sugar and water.

"**Bacteria.** Make reduction for excessive number of bacteria. Importance of bacterial counts has not as yet been sufficiently considered by the committee to warrant definite recommendations."

* These standards have since been changed. See standards at the beginning of this chapter.

Later (1923), the committee recommended that the score card for condensed and evaporated milk be changed by having the points allowed for body and texture and bacterial count increased, and the points allowed for fat and flavor decreased.

Mojonnier and Troy (1925) suggested the following score card for sweetened condensed milk:

Item	Perfect score	Remarks
Viscosity	10	Neither too light nor too heavy in viscosity. Sufficiently fluid to pour from container.
Homogeneity	10	No fat separated. No milk sugar settled upon bottom of container. Product smooth to taste and free from foreign matter.
Color	5	Slight yellowish cast. Neither too light nor too dark.
Flavor	25	Clean milk flavor without any foreign flavor other than the sugar added.
Odor	2	No appreciable odors of any kind. No signs of yeast development.
Solubility	5	Product to dissolve freely in water, without showing any undissolved matter.
Appearance of container	3	Neat label, properly applied. No rust spots upon the tin surfaces. If bulk container, should be neat and attractive.
Bacteria	10	Bacteria to be present in amounts not to exceed the limits found in properly pasteurized milk. No yeast cells to be present.
Fat	10	Fat to be not under legal or trade standards. Score for fat to be added to total solids in the case of the skimmed product. No foreign fats allowed.
Sugar	5	For sweetened condensed skimmilk sugar to be about 42.00 percent, and for whole milk about 44.50 percent.
Total solids	10	Milk solids to conform to legal standards. Total solids to conform to trade standards. No adulterants.
Net weight	5	To be not under amount specified upon the label.
Total	100	

Procedure of Examination

Certain precautions and steps such as were necessary in judging evaporated milk are not necessary in judging sweetened condensed milk. However, a definite routine enables the judge to make the best use of his time with the assurance that when he has finished, the examination is complete.

1. *Place the can* on the table for examination *in the same upright position in which it had stood prior to examination.* This enables the judge to open the top of the can and to examine the contents at the surface and at the bottom to the best advantage.

2. *Note the appearance of the container.* The container should be in good condition. Since the can has not been subjected to the high heat treatment of sterilization which dulls the surface of the container, the ends of the can should be as bright as new tin. However, it is well for the judge to get into the habit of observing carefully the condition of the container.

3. *Cut and turn back the top of the container* so the surface of the milk may be examined and that the contents may be poured out readily.

4. *Examine the sweetened condensed milk for appearance.*

   a. *Surface.* The surface should have the same intensity of color as the underlayer and should be uniform in consistency with no indication of lumps.

   b. *Color.* With a spatula, "spoon up" some of the product. Notice the translucency of a layer of the milk. Notice if the color is uniform throughout or if there is a lighter colored layer at the bottom of the container. Especially observe whether the milk has a creamy or a brownish color.

5. *Note the relative viscosity.* Tilt the container, noting meanwhile the readiness with which the product tends to seek its own level. Pour the contents into a beaker. The desired viscosity is one which is obviously not "thin" but resembling to a marked degree that of heavy molasses. There should be no indication whatsoever of a jel or a custard formation.

6. *Look for a grainy sediment.* After the can has been emptied scrape the bottom noting the presence or absence of a thickened layer which may be composed largely of crystalline material. Compare the color of the material with that of the

bulk of the milk. Feel the size of the crystals settled out and compare them with those suspended in the liquid.

Defects of Sweetened Condensed Milk

Flavor. Sweetened condensed milk, being concentrated under vacuum will have none of the volatile off-flavors which occur frequently in fresh milk. Being preserved by sugar instead of heat, it will not have the flavors resulting from the high-heat treatment of the product such as are associated with evaporated milk. Therefore, when the product is properly made it is remarkably free of flavor defects. However, some off-flavors in sweetened condensed milk have been noted, as indicated below, with which the dairy products judge should be familiar.

1. Metallic
2. Rancid
3. Strong
4. Tallowy

1. Metallic. The metallic flavor in sweetened condensed milk is chemical rather than bacterial in nature and is usually traceable to copper contamination. Hunziker (1935) states that "sweetened condensed milk not infrequently is pregnant with a pronounced, disagreeable metallic flavor suggesting the puckery, coppery taste of copper salts." The metallic taste is not unlike the metallic taste in other dairy products and should not be difficult for the dairy products judge to recognize.

2. Rancid. This flavor defect in modern condensed milk occurs rather infrequently. Rice (1926) describes the flavor as resembling butyric acid. He states that the flavor once observed is never forgotten. Rancidity results from the hydrolysis of the fat due to enzymes secreted by bacteria or those in the milk itself which have not been inactivated by heat. The rancid flavor increases in intensity with age. If the milk is rancid, the peculiar, offensive odor associated with rancidity may be noted when the can is first opened.

3. Strong. The term "strong" or "strong-caramel" is suggested to describe the flavor accompanying progressive thickening and browning of condensed milk. While this flavor must be classed as a defect it is not a serious one. Unfortunately, the set, caked or jelled product with its deep-brown color suggests that the product might have undergone serious flavor impairment. However, such milk has taken on a rather pleasant cara-

mel-like taste. When the flavor is not accompanied by a strong after-taste the off-flavor is not the most serious phase of this age defect.

4. Tallowy. Hunziker (1935) stated that the tallowy flavor in sweetened condensed milk was much less prevalent than rancidity and was less pronounced than in tallowy butter. The defect, as the name implies, resembles tallow. Rice (1926b) observed in case of tallowy condensed milk, that "on opening a tin the sample appears sometimes, but not always, a little paler than normal. The tallowy flavor of the freshly opened sample remains even after exposure to the air for several days."

Body and texture. Condensed milk, having a high percentage of sugar for preservation, always has a heavy body somewhat like molasses. Also, it usually has a fine-grained, smooth, uniform texture. However, the product may have certain body and texture defects with which the judge should be familiar. These defects are usually referred to as:

1. Buttons, lumpy
2. Fat separation
3. Gassy
4. Sandy, rough, grainy
5. Settled
6. Thickened

1. Buttons, lumpy. Buttons are shown by the presence of round, firm, cheesy curds on top of the condensed milk. These areas are discolored, being of a brownish hue. Buttons result from enzymic action following mold growth. Lumpy condensed milk, as the name indicates, is that condensed milk in which areas of pronounced differences in viscosity exist usually to the extent that some portions have jelled. Both these defects are rather uncommon. The judge should experience little difficulty in recognizing these defects if and when they occur.

2. Fat separation. Fat separation in sweetened condensed milk is rare. When the condition exists it will be noted by a film or layer of fatty material of a different shade of color at the top of the container.

3. Gassy. A gassy condensed milk may be recognized by the "bloated" or "huffed" can. This defect results from contamination and growth of gas producing organisms. The defect is rare and is of such a nature that the dairy products judge will

have no difficulty in recognizing the defect. Hammer (1919b) studying the formation of gas in sweetened condensed milk, found the causative agent to be a yeast which he named *Torula lactis condensi.* There was a yeasty odor associated with this gaseous condition.

4. *Sandy, rough, grainy.* These terms are used to describe sweetened condensed milk which contains lactose crystals. The solid particles are of such size that the product lacks smoothness and a grittiness is noticeable as the sample is being tasted. The defect is readily detected by the average consumer. The sandiness is due to the presence of relatively large crystals of lactose. Even in so-called "smooth" condensed milk very fine lactose crystals are present. These may be noted by the experienced judge as if a fine "flour" were mixed with the condensed milk. If manufacturing conditions are not conducive to the formation of small lactose crystals, large, coarse crystals are formed causing the defect.

5. *Settled.* The term "settled" is one used to describe a condensed milk in which a definite settling of lactose crystals and/or sucrose crystals have occurred. The syrup which settles out forms a thick sugary layer in the bottom of the container. A product of relatively low viscosity is usually associated with this defect. Hunziker (1935) describes this defect as follows: "This defect refers to sweetened condensed milk in which a portion of the sugar crystals have dropped to the bottom of the tin or barrel, forming a layer of sugar deposit varying in thickness from a thin film to a layer an inch or more thick. The physical character of this sediment varies in different cases. It may be soft and, upon stirring, may readily emulsify with the contents, or it may be coarse, hard and dry, in which case it adheres with great tenacity and refuses to emulsify with the milk. Settled milk is a common condensed milk defect and it is objected to by the trade."

6. *Thickened.* Thickened condensed milk is one of the more common defects encountered in sweetened condensed milk. The defect is manifest by a jel formation which gives the product the appearance of a solid rather than a liquid. Usually thickened condensed milk is associated with browning, both of which become progressively more intense upon storage, especially at room

temperatures or above. The defect varies markedly in its intensity from a slight jelly to a firm custard consistency. In judging sweetened condensed milk, the judge must bear in mind that a desirable sweetened condensed milk pours like thick molasses and, when poured, seeks its own level leaving no trace of the folds on the surface. The formation of a jel, even a soft jel, is not desired. Often the thickened product fails to dissolve when added to coffee.

PLAIN CONDENSED MILK

In judging plain condensed milk the judge must bear in mind that this product is manufactured very much like evaporated milk. The two main differences are (a) the product is usually superheated to increase its viscosity, and (b) the product has not been subjected to sterilization temperatures. Consequently, a high-quality plain condensed milk will have a relatively viscous body and be free from the taste characteristics of evaporated milk. The product is neither sterile nor preserved by sugar. Its keeping qualities compare favorably to that of high-quality fresh milk. The flavor of the finished product is dependent in large part upon the pre-heating and superheated temperatures used. If the product is not superheated and a low forewarming temperature is employed, the product will be free from the distinct "cooked," "boiled" taste of a high-heat treated product. However, a mild concentrated or heated flavor will be apparent. In judging this product the judge should be aware of the possible defects in the product.

Flavor. As mentioned previously, the product is relatively free from flavor defects. Since the product is not sterile, the chief flavor defects of a serious nature will be those associated with bacterial decomposition. The development of a clean, sour taste is exceptional. The developed flavor usually results from proteolysis, yielding an unclean, slightly offensive taste and odor.

Body and texture. The chief defect which may be noted in plain condensed milk is that resulting from improper control of the superheating process. As mentioned previously, plain condensed milk is superheated to increase its viscosity. If the superheating process is not properly done the product appears coarse and grainy. Close examination will reveal coagulated protein and some free whey.

Score Card for Plain Superheated Condensed Whole or Skimmilk

Mojonnier and Troy (1925) suggest the following score card for plain superheated condensed whole or skimmilk.

Item	Perfect score	Remarks
Viscosity	15	Heavy viscosity. Product to flow freely from container.
Homogeneity	15	Smooth, velvety appearance. No visible specks or lumps.
Color	10	Light, white, milky color.
Flavor	30	Good, clean milk flavor. No foreign flavors.
Odor	5	No appreciable odors of any kind.
Appearance container	5	Container to be neat, clean and with all evidences of good workmanship.
Fat	10	No foreign fats. Fat content to conform to legal or trade requirements.
Total solids	10	No preservatives of any kind. Total solids to conform to legal or trade requirements.
Total	100	

BOTTLED CONCENTRATED MILK

Meredith and Stoltz (1935) pointed out that this product is normal whole milk concentrated 2:1, bottled and distributed similarly to fresh milk. As to flavor, they mentioned that the product was free of feed flavors and that the reconstituted product frequently was flat. The judge should be familiar with these flavor characteristics when judging this product. Since the product is homogenized, he should observe also the possibility of the occurrence of any of the defects of homogenized milk such as sedimentation.

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Review Questions

1. Give the general characteristics that distinguish evaporated milk from condensed milk.
2. Compare the flavor defects in evaporated milk with those found in bottled concentrated milk.

3. What important items on the score cards for evaporated milk and for condensed milk do not appear on the score card for market milk?
4. How does the procedure for the examination of evaporated milk differ from that followed for the examination of condensed milk?
5. Why should undue agitation be avoided when transporting evaporated milk to the laboratory for examination?
6. Give the reason why more attention should be paid to the appearance of the container of evaporated milk than to the appearance of the container of condensed milk.
7. What is the most common color defect of evaporated milk?
8. Name the most common flavor defect of evaporated milk and the other characteristic commonly associated with it.
9. How does the titratable acidity of evaporated milk held at a low temperature compare with the titratable acidity of the same milk held at a high temperature?
10. List the body and texture defects of evaporated milk and underline the one that is likely to be found most frequently.
11. What is the chief cause of sedimentation in evaporated milk?
12. Name the most common flavor defect of condensed milk and the other defect generally associated with it.
13. Give the most prevalent body and texture defect of condensed milk.
14. What effect does superheating have on plain condensed milk?
15. If the superheating of plain condensed milk is carried beyond the critical point, what defect is likely to result?
16. Name the most prevalent defect found in bottled concentrated milk.

CHAPTER XII

JUDGING DRY MILK SOLIDS

Since the beginning of its manufacture, dry milk has been subject to certain aspects of grading based upon analyses such as bacteria count, moisture content and physico-chemical properties and, in some cases, products have been graded for the use to be made of them. Not until recently, however, has special attention been given to the grading of dry milk solids in which the flavor quality is emphasized. More and more, emphasis is being placed on the improvement of the flavor of the product. Regardless of the state of perfection of other desired characteristics, dry products of milk must have satisfactory flavor characteristics in order to have appeal for human consumption. The importance of flavor is governed in some degree by the intended use of the products but certain minimal requirements apply to all types and grades. The judge of dry milk solids must be familiar not only with the standards for the product and the type of laboratory tests for checking those standards, but also with the quality standards and the flavor defects to which the particular type of solids is susceptible.

Methods of Processing

There are three general processes by which dry products of milk are made, namely, (a) the spray process; (b) the atmospheric roller process; and (c) the vacuum-drum process. The nature of dry milk products obtained vary markedly according to the composition of the fluid prior to drying and according to the method of manufacture. The method of manufacture gives certain qualities to dry milk which may be used as an aid in determining the process of manufacture. The general differences in the three processes and the general characteristics of the product obtained by each process are as follows:

1. Spray process in which the milk is sprayed under high pressure into a current of filtered heated air in a drying chamber. The product made by this process is fine grained, rather fluffy

and readily soluble. Under the microscope the grains appear beady, spherical and are relatively uniform in size.

2. *Atmospheric roller process* in which the milk is dried in open air on the surface of revolving, internally heated drums. The dried milk film is scraped off each of the twin drums, ground and bolted. The product may be characterized in general by its relatively heavy body, coarse texture and comparative insolubility when first added to distilled water. Under the microscope the solids appear angular, flaky and irregular. Seldom will spherical grains be noted.

3. *Vacuum-drum process* in which the drying is accomplished the same as with the atmospheric roller process except that the rolls are enclosed in a vacuum chamber thus permitting drying at a lower temperature. Vacuum-drum powder appears to go into solution readily when added to distilled water similar to spray-process powder but may be distinguished easily from the latter by its appearance under the microscope. Grains of spray-process powder are generally spherical whereas those of the vacuum-drum process are generally distinctly angular and fragmented.

Classification of Dry Milk Products

Dry milk products may be grouped under the following headings:

1. Dry whole milk
2. Nonfat dry milk solids
3. Dry buttermilk solids
4. Dry cream
5. Dry whey solids
6. Dry ice cream mix
7. Malted milk

The description of each of these products will be given with the discussion on grading of the product.

Standards

Federal standards for dry products of milk. The Federal Government, by act of Congress (1944), established a standard of identity for nonfat dry milk solids as " . . . the product resulting from the removal of fat and water from milk, and contains the lactose, milk proteins and milk minerals in the same

relative proportions as in the fresh milk from which made. It contains not over 5 per centum by weight of moisture. The fat content is not over 1½ per centum by weight unless otherwise indicated." The dry milk industry has defined dry whole milk as " . . . the product resulting from the removal of water from milk and contains not less than 26 percent milk fat, and not more than 5 percent of moisture." Industry definitions for dry buttermilk solids and dry whey solids are of similar nature.

In addition, the Government has issued federal specifications (1943) for nonfat dry milk solids and dry whole milk. The U. S. Army (1942) and the Department of Agriculture tentative standards (1943) specify grade requirements for nonfat dry milk solids and for dry whole milk which are patterned after the industry standards, referred to below, published by the American Dry Milk Institute. The description of these grades is given in full in the Appendix. Here it may be stated that greater leniency in the percentages of moisture, fat and acidity, and in the solubility index, bacteria count and amount of sediment present is shown in the "standard" grade than in the "extra" grade.

Industry standards for dry products of milk. The dry milk industry has adopted standards for nonfat dry milk solids and dry whole milk. These are based upon general product quality and formulated to give two or more grades of finished product. General requirements for each product applicable to all grades are designed to assure quality and sanitation of fluid milk supply, processing and packaging of the finished product. Specific requirements for each grade are those that indicate the necessary composition and quality for the finished dry product. Grading of the product is based upon the following analyses:

1. Nonfat dry milk solids — moisture, fat, titratable acidity. sediment, solubility index, bacterial estimate (Standard plate count), color, flavor and odor.

2. Dry whole milk — moisture, fat, titratable acidity, sediment, solubility index, bacterial estimate, copper, iron, color, flavor, and odor. In addition, oxygen content of the headspace in the container is determined if the product is gas packed.

It is out of the realm of this discussion to consider herein the laboratory procedures involved in grading dry milks. These may be had in bulletin form from the American Dry Milk Institute, Inc., 221 N. LaSalle Street, Chicago 1, Illinois. Only those prop-

erties of dry products of milks in which the senses of sight, smell, taste and touch are used are considered in detail in this chapter.

Organoleptic Grading

Score cards for dried milk products. Specific score cards for dry whole milk or for nonfat dry milk solids have not been drawn up or approved by the American Dairy Science Association. However, Mojonnier and Troy (1925) have suggested a score card for dry whole milk, nonfat dry milk solids and dry cream, with explanations, which is as follows:

Score Cards for Dry Whole Milk, Nonfat Dry Milk Solids and Dry Cream

Item	Score	Allowed	Remarks
Flavor	50		Fresh, clean flavor resembling that of the fluid products. No signs of rancidity.
Odor	5		Clean, agreeable odor. Suggestion of good milk products.
Solubility	10		For certain uses, powder should be completely soluble. For other uses solubility is relatively unimportant.
Appearance	10		Pleasing appearance. Homogeneous and free from lumps or specks.
Composition	15		Not to exceed 5 percent of water.
Bacteria	10		Not to exceed limits usually found in properly pasteurized milk.

"Flavor. — This largely determines the commercial value of all milk powders. The first signs of decomposition usually manifest themselves in the flavor. The principal defect in flavor is caused by rancidity. Any considerable amount of rancidity renders the powder unfit for human food. No method of treatment has yet been found that will completely eliminate rancidity after it has been once developed. The flavor should be very similar to that of the fluid products from which the powders were made.

"Odor. — No bad odors of any kind should be noticeable. Bad odors usually indicate either improper manufacturing processes, or decomposition of the product.

"Solubility. — The importance of solubility depends upon the use to which the powder is to be placed. Powder made by the spray process is usually more soluble than that made by the roller process. If the powder is to be reconstituted or used for making ice cream, it is very important that it be completely soluble. If it is used for making milk

chocolate and other food products, its solubility is relatively not important.

"Appearance. — White to slightly yellowish cast. No dark lumps or specks. Powder is to be homogeneous throughout.

"Composition. — Water content not to exceed the Federal Standard of 5 percent. The less water the better, since the presence of water is the most common cause of spoilage. The fat and total solids are to conform to the legal or trade requirements."

Flavor grades. When grading dry products of milk for flavor it becomes necessary to place the samples into definite classes according to the intensity of the flavor defect. The American Dry Milk Institute (1942) recommends classifying the flavor of the reconstituted product approximately one hour after reconstituting as: good, fair or poor.

Lea and co-workers (1943) evaluated the flavor of dry milk more specifically. They explained:

> "From a purely practical point of view the most important changes occurring in milk powder on storage are changes in odor and flavor. The quantitative assessment of flavor is always a matter of difficulty owing to the variation in sensitivity found between different individuals and for the same individual at different times, to the fatigue and resulting loss in sensitivity experienced in tasting a series of samples, and to the disturbing influences which may in themselves be sufficiently strong to invalidate completely the judgment given. When, as in the present case, a series of observations over a period of months is required further difficulty is experienced in maintaining a reasonably consistent standard of grading. For this reason, and because it was desired to average the marks given by a tasting panel of five people, a scale of only five grades was adopted, each representing a condition easily describable in words.
>
> The grades were defined as follows:
>
> 0 = as good as the control
> 1 = a suspicion of 'off' flavor
> 2 = a definite 'off' flavor
> 3 = unpalatable
> 4 = very unpalatable
>
> "Samples averaging below 1 would be considered good, between 1 and 2 usable, and between 2 and 3 unusable (except perhaps for cooking or manufacture). Samples averaging above 3 were very unpleasant to taste. There is, of course, no suggestion of proportionality between the

number given according to this scale and the intensity of 'off' flavor; in a sample marked '1'. An approximately straight line flavor time relationship from zero to 3 or 4 as frequently obtained does not therefore indicate a uniform increase in intensity of flavor with time, but is consistent with the existence of an appreciable induction period as shown by the oxygen absorption and peroxide curves. The scale used has, however, the advantage of sensitivity in the earlier and more important stages of deterioration. Later on, when, for example, it becomes necessary to decide whether a sample is 'unpalatable' or 'very unpalatable,' some inconsistency is inevitable, though this is reduced by averaging the verdicts of five independent tasters, and by having tasting panels at three different research laboratories. In a few instances tests were also made by groups of untrained observers."

In keeping with the intensities of the off-flavors of milk (p. 104) it would seem that the grades of off-flavor of dry milk could well be

—, or 0 = no off-flavor
?, or 1 = questionable
+, or 2 = slight off-flavor
++, or 3 = distinctly off-flavor
+++, or 4 = pronouncedly off-flavor

These grades are essentially the same as those used by Lea and co-workers (1943).

Methods of Reconstituting Dry Milk Solids for Flavor Examinations

Generally in examining dry milk solids for odor and taste the product is reconstituted on the basis of the original concentration. For this purpose distilled water is commonly used. The possibility of grading milk solids for these organoleptic properties without reconstitution must not be overlooked, however. The American Dry Milk Institute (1942a) recommends examination of dry products of milk for odor immediately after the containers are opened and again for flavor approximately one hour after the sample of solids has been reconstituted. For reconstitution procedure they recommend adding 10 grams of nonfat dry milk solids (9%) or 13 grams of dry whole milk (11.5%) to 100 ml. of distilled water at a temperature of 75° F. (23.8° C.) in an 18- or 20-ounce tumbler and immediately agitating vigorously by the use of an electric

mixer for 90 seconds. Federal specifications also follow this procedure.

Waite (1941) reconstituted dry whole milk by adding 8 gm. of powder to 64 ml. of water (11.1%) at room temperature, but failed to specify the kind of water used, and the nature and extent of agitation.

Hollender and Tracy (1942) reconstituted dry whole milk by adding 10 gm. of the dry solids to 80 ml. (11.1%) of 100° F. (37.7° C.) distilled water agitating in a malted milk mixer for 30 seconds and then cooling.

Lea, Moran, and Smith (1943) mixed the milk powders with water at 60° C. (140° F.) in the proportion of 14 gm. (dry whole milk) or 10 gm. (nonfat dry milk solids) to 100 ml. of water (12.3% and 9.1% respectively) stirred well and cooled to 20° C. (68° F.)

Apparently in the organoleptic examination of dry milk solids research workers prefer to reconstitute the milk to the original total solid basis before passing judgment on flavor of the samples. However, it must not be overlooked that the odor test of the dry milk solids is of material value in obtaining information on its flavor quality. Waite (1941) recognized the value of the odor test in grading dry whole milk. In his extensive studies he advised his graders to smell the samples first in order not to contaminate the palate at the beginning of judging with a tallowy flavor. Thus, by the sense of smell the samples were first placed in an agreed order so that the tallowy ones could be tasted last. The American Dry Milk Institute (1942a) recommended examining the dry samples for odor immediately after the containers were opened. Following a lapse of one hour after reconstituting, the samples then were graded organoleptically for flavor.

Lea and co-workers (1943) stated:

> "The odor of the powder after standing in a stoppered bottle certainly offers a very sensitive indication of deterioration, but is troublesome to apply in a standard way as a routine test. Tasting the solid powder is of relatively little use because the sweet taste due to the local concentration of lactose on the tongue tends to mask 'off' flavor, while at the same time the solids powder clogs the palate and induces rapid fatigue. Even in tasting reconstituted milks it was found to be advisable to place the samples

roughly in order according to odor, and then to taste them in that order, starting with the best."

Washburn (1922) observed:

> "It is said that 'the nose knows,' but in the case of milk the nose may know too much. Not infrequently dehydrated milk of various types will give off an unpleasant odor when the tin is first opened, but will still reconstitute into a liquid milk wholly above criticism. Desiccated whole milk is far more likely to become tallowy than rancid or in other words oxidation rather than hydrolization takes place. But in the case of either the nose can detect its presence or its approach in advance of any but the most extremely delicate chemical test, and far ahead of the tongue."

Thus it would seem that ascertaining both the odor of the dry product and the odor and taste of the reconstituted product is extremely important if dry milk solids are to be graded organoleptically.

For reconstituting dry milks it would appear that industry and federal standard procedure should be followed. These are based on the rates of 10 grams of nonfat dry milk solids or 13 grams of dry whole milk per 100 ml. of distilled water — approximately 9 and 11.5% total solids respectively. The latter figure is recommended because the resultant reconstituted product is comparable in fat and total solids with minimum requirements for fluid milk in many states. At least one hour should elapse following reconstitution and before tasting in order to secure a blend of flavor. The judge must be mindful of the fact that freshly prepared fluid milk made from water and good quality dry whole milk often possesses a slightly chalky, watery or slightly cooked taste. Hence permitting a rest period for blending of flavors after reconstituting the product should aid the judge in determining more accurately the true flavor.

DRY WHOLE MILK

Authorities are in quite good agreement as to the desired organoleptic qualities of dry whole milk. The American Dry Milk Institute (1947) states that dry whole milk should be classified for flavor as good, fair or poor. Off-flavors should be characterized by such terms as storage, stale, tallowy, rancid, metallic, scorched or flat. Porcher (1929) gave no grade classification of dry milk but described the organoleptic properties as follows:

"**Fineness:** The powders prepared by the spray process are extremely fine and very homogeneous. When rubbed between the fingers they give a sensation of smoothness, and somewhat of a 'crackling' like potato starch; this is particularly true in the case of skimmed milk powder; in the case of whole milk powder a sensation of even greater smoothness is evident.

"The powders prepared by the cylinder process evidently do not have the smoothness and homogeneity of the spray process powders because of the manner in which they are produced. They result, in fact, from a very much coarser pulverization, from a sort of breaking up, it would perhaps be better to say, of a thin and very friable sheet which the knife detaches from the cylinder, and accordingly it is easily seen that they do not have the fineness of the powders produced by the spray process.

"**Lightness:** For equal volumes, and without appreciable compaction, powder prepared by the cylinder process is much lighter than the other. It is desirable to note this difference because it is not unimportant. If, instead of weighing, we measure with a spoon the quantity of powder necessary for a feeding, we might easily be deceived as to the correct proportions. We shall discuss a little further on the value of this important point in discussing the preparation of infant food.

"**Microscopic appearance:** Under the microscope the powder produced by the spray process is found to be composed of tiny spherical masses of variable diameters. The powder produced by the cylinder process has the form of irregular scales, varying in their dimensions and having bewildering confusing striations.

"**Color:** The color of the powders, irrespective of the process of preparation, is caused by the amount of fat which they contain. They are of a butter-yellow color when the fat content is high; whitish and with but little yellow color when made from skimmed milk; and when made from partially skimmed milk, the color is between the two.

"**Odor:** The freshly prepared powders have an agreeable and appetizing odor like that of fine pastry, but they lose this odor more or less rapidly according to whether they are fatty, half skimmed, or skimmed, well or poorly desiccated, whether or not the moisture content is high or low, and according to the process by which they have been prepared.

"The drying of the milks, as we shall see a little further on, destroys almost all of the bacteria; and since bacteria need water for their development, we can readily under-

> stand that they can develop in the powder only with great difficulty. Dry milk powder would have to contain a high percentage of moisture for their rapid multiplication and such a condition is never the case.
>
> "Although very well prepared dry milk is free, on the whole, from bacteria, it is nonetheless subject, if we consider it as an aggregate of chemical bodies, to certain reactions, which, in time manifest themselves. We wish to speak here of the changes well known to all those who are interested in dry milk, and who have had experience with it, and which affect principally the solubility and the odor."

Flavor. *The flavor of dry whole milk should be clean, rich, sweet and very pleasant not unlike that of fine pastry.* Frequently dry milk solids may be unduly criticized as having a "heated" or a "cooked" taste. This may be expected, or even desired. Washburn (1922) states that:

> "Powder which may reveal the first traces of oxidation of fat to the nose or which may give some of the so-called 'condensed milk taste,' when tasted in the powder form will not, when constituted and cooled, give any concern. Moreover, when all the people learn that the 'cooked' taste is a sweet taste, made by the processes that protect them, they will look for and even seek that 'sweet taste of safety.'"

If the dry milk does not have a distinctly "burnt" taste, the cooked, and heated flavors will not be considered herein as a defect.

Often as dry milk ages it gradually loses the fine, appetizing, pastry flavor and becomes more or less off-flavored. The flavor defects of dry whole milk may be classed as follows:

1. Stale, storage, old
2. Rancid
3. Oxidized, tallowy
4. Scorched

1. Stale, storage, old. This flavor defect of dry whole milk appears to be a characteristic age defect and one which seems to be associated with the constituents other than fat, chiefly protein. When the defect is intense it may be accompanied by a darkening of the product. However, this off-flavor usually is noticeable long before any discoloration may be perceived.

2. Rancid. Rancid dry whole milk has a bitter, soapy, unclean taste which is persistent after the sample has been expectorated. Such a product is definitely unpalatable. The defect

rarely occurs in modern, controlled dry whole milk manufacture. The off-flavor rarely develops in roller process product. When encountered in spray dried products it may be traceable to the processing in which forewarming temperatures have not been sufficiently high to inactivate the enzyme lipase.

3. Oxidized, tallowy. The oxidized, tallowy flavor is the most troublesome flavor defect of dry whole milk. Not only is the flavor, which suggests tallow, such that the product is unpalatable, but occurs most frequently of all flavor defects of the product. Various stages of tallowiness may often be noted, for many factors affect the development of the defect. Such factors as temperature, light, moisture, acidity, metallic salts, condensation, homogenization and type of packing influence the rate of oxidation.

4. Scorched. This flavor is produced in products which have been subjected to excessive heat during the drying stage or permitted to stay in the drying chamber for an excessive period of time. It is usually accompanied by excessive scorched specks in the product and sometimes by dark color typical of overheated stock.

Physical Characteristics

Fineness and homogeneity. (Body and texture.) The fineness of dry whole milk is dependent upon several factors, such as the drying process, degree of concentration prior to drying, and fineness of bolting. Dry whole milk prepared by the spray process is extremely fine and uniform throughout. Products prepared by the roller process usually are not as fine, smooth and homogeneous.

Two defects pertaining to the body and texture of dry whole milk may be noted:

1. Lumpy
2. Caked

1. Lumpy. A lumpy powder definitely lacks homogeneity. Hard lumps ranging in size from a grain of wheat upwards may be interspersed throughout the solids. This defect is found more frequently in the spray-process product. The lumps result from insufficient drying, drippage from the spray nozzles or exposure to moisture-laden air. Dry whole milk, because of its relatively high fat content, usually contains soft lumps of prod-

uct. This is particularly characteristic of cold product and is due to agglomeration of particles. It should not be confused with a "lumpy" product, in which the lumps are firm when pressed between the fingers.

2. Caked. Caked dry whole milk has lost its powdery consistency and has become a rock-like solid. The solid mass may be broken up into chunks, but fails to return to its original state. This defect is serious as such solids have lost their sales value for human consumption. The defect is usually the result of exposure to moisture and subsequent crystallization of the lactose. This defect is not usually encountered in dry whole milk.

Color. Dry whole milk is usually light yellow in color but varies seasonally with the color in the fat from a creamy white to a deep yellow.

The defects of color in dry whole milk follow:

1. Browned or darkened
2. Scorched
3. Lack of uniformity

1. Browned or darkened. This defect is associated with age. When the defect is present, there is a definite lack of normal creamy color and in its place is a distinct brown color. The defect is usually associated with an old, stale flavor.

2. Scorched. Discoloration due to burning of the milk solids is usually associated with the roller process rather than with the spray process. The powder may vary from a light to a dark brown. Rarely will burnt particles be so dark as to appear black. Solids showing discolored particles or foreign sediment are discriminated against.

3. Lack of uniformity. This defect may be due to either partial discoloration (browning) after packaging or to partial scorching during the manufacturing process. When the products are packed in small units the browning usually proceeds from the surfaces. When packed in large units (barrels, etc.) the browning usually proceeds from the center of the product to form a core.

NONFAT DRY MILK SOLIDS

Flavor. The flavor of high quality nonfat dry milk solids is similar, when reconstituted, to that of fresh separated milk. Because of the low fat content it does not possess the rich pastry flavor of higher fat content products. The flavor is clean, sweet

and pleasant and may possess a slight cooked or heated flavor. Likewise the off-flavors of reconstituted nonfat dry milk solids have much in common with those of dry whole milk, but differ in their relative importance. The chief flavor defects of nonfat dry milk solids are as follows:

1. Stale, storage, old
2. Scorched
3. Oxidized, tallowy

1. Stale, storage, old. This flavor defect is the chief one of nonfat dry milk solids. In this product the off-flavor is even more "quick" and distinct than in dry whole milk. Usually the flavor defect is accompanied by a darkening of the powder. However, the staleness may be detected before any change in the color may be noted. In very old, darkened product a sharp, slightly sour taste may be detected after the first sensation of staleness has disappeared. This slightly sour taste is very similar to that noted in darkened evaporated milk which has resulted from storage at a high temperature for an extended period. Lea and co-workers (1943) described this off-flavor of separated milk powders as "burnt," "stale," or "glue-like." They believed that the burnt flavor might result from a blend of the "toffee" flavor in the fat, a slight caramelization of the lactose and the stale flavor resulting from changes in the protein. Usually the old, stale flavor develops more intensely in spray-process powders than in roller-process powders.

2. Scorched. As in dry whole milk this flavor is produced in products which have been subjected to excessive heat during processing. It is usually accompanied by excessive scorched specks in the product and sometimes by dark color typical of overheated stock.

3. Oxidized, tallowy. The tallowy flavor, which is the chief flavor defect of dry whole milk, is not encountered so frequently in nonfat dry milk solids. Since it is a fat-associated flavor, it develops only when appreciable fat is present. Nonfat dry milk solids always contains a small (less than 1.5) percentage of fat which oxidizes under some conditions yielding the oxidized or tallowy flavor. Tallowy product has a pronounced odor whereas stale powder does not have a very intense odor.

Physical Characteristics

Fineness and homogeneity. As with dry whole milk the fineness of good quality nonfat dry milk solids is dependent upon nozzle size and concentration prior to drying when spray dried; and mainly upon degree of pulverization and mesh of bolting when roll dried. Nonfat dry milk solids prepared by the spray process is very fine in particle size and uniform throughout. Unless finely pulverized the material prepared by the roll process is characteristically coarser and less homogeneous. The defects are the same as those noted for dry whole milk.

Color. Nonfat dry milk solids, like dry whole milk, should be uniform in color throughout showing the absence of foreign specks and burnt solids. The product should have a creamy white or light yellow color which varies slightly in intensity with the season of the year. Upon aging under certain conditions nonfat dry milk solids tends to darken. When this defect occurs the light yellow color has given way to a definite brown. This defect is usually associated with the old, stale flavor. Spray-process products appear to be more susceptible to age darkening and to a greater intensity than roller-process powder. However, both processes are subject to this defect. Both products may show scorched coloration described for dry whole milk.

DRY BUTTERMILK SOLIDS

Dry buttermilk solids is the product resulting from the drying of buttermilk obtained from the churning of sweet cream. Sweet cream is generally recognized as cream with a titratable acidity not exceeding 0.20 percent calculated as lactic acid.

Flavor. The flavor of dry sweet cream buttermilk solids should be clean, sweet and pleasant having a somewhat richer flavor than nonfat dry milk solids. Whereas the latter contains less than one and one-half percent fat, dry sweet cream buttermilk solids contains from 4.8 to 8.4 percent fat (Davis, 1939). Davis (1939) found that of 11 samples analyzed, 10 or 91 percent of them contained more than 5.0 percent fat. With this much fat present the solids should have a richer, fuller flavor than nonfat dry milk solids. On the other hand, it must be remembered that buttermilk is rich in lecithin, a fatty constituent which is highly oxidizable, and powder made from it may be subject to more rapid flavor deterioration. The off-flavors in buttermilk solids stored for one year in different containers and at different

temperatures as noted by Davis (1939) were: stale, old, musty, sharp, bitter, soapy, coarse, cheesy, rubbery, acid, fruity, tallowy and putrid. Several of these off-flavors were noted in various intensities. Thus in judging dry sweet cream buttermilk solids for flavor a wider range of off-flavors may be noted than when judging nonfat dry milk solids for flavor.

Physical Characteristics

Fineness. (Body and texture.) The body and texture characteristics of sweet cream buttermilk solids are very similar to those of nonfat dry milk solids. The process of manufacture has similar effect on the fineness of the product. Spray-process products usually absorb moisture more readily than those made by the roll-process. The presence of excessive moisture, in spray-process products particularly, favor their lumping or caking.

Color. The color of sweet cream buttermilk solids compares very favorably with that of nonfat dry milk solids and is subject to the same defects chief of which is age darkening.

DRY CREAM

Dry cream has never been produced in any appreciable quantity in the United States largely because other sources of butterfat were available for the needs which might be fulfilled through the use of dry cream. However, increased interest may be shown in dry cream manufacture as a result of improvements in whole milk drying techniques and the unprecedented demand for dry ice cream mix of which dry cream may be an ingredient. The dairy products judge should be familiar with the taste and texture qualities of dry cream. This product is very high in fat, the percentage being approximately 70 percent as compared to 26 percent fat in dry whole milk. Consequently, dry cream is much smoother than dry whole milk. In fact, the product is so smooth that the texture appears and actually feels oily. The development of a tallowy or oxidized flavor upon storage is the chief defect of the product. This off-flavor is similar to that which may be noted frequently in aged dry whole milk.

DRY WHEY SOLIDS

Dry whey solids is a comparatively new dairy product of increasing commercial importance. Its chief uses in human consumption are in the confectionery and baking industry and in the manufacture of certain dairy products. Several modifications

of the roller and spray process are employed in the manufacture of dry whey. The organoleptic qualities of dry whey vary slightly with the method of manufacture. Davies (1939) explains:

> "The drying of whey on rolls is accompanied by a certain amount of caramelisation of the lactose. The use of more concentrated whey, partial neutralisation, and mixing the whey with separated milk, give a better coloured product. The whey comes off the rolls as a gummy solid, which crystallises to a hard cake on cooling. This material is easily ground to a creamy powder, which has rather a 'sandy' effect when tasted. The colour naturally depends on the amount of caramelisation during drying, but what appears to be a very brown product coming off the rolls grinds to a powder of better colour. The inclusion of separated milk naturally improves the colour. The dried cake tends to clog the stones or beaters on grinding.
>
> "The powder is hygroscopic but, owing to its high lactose-content, and to the fact that the lactose has crystallised as the monohydrate, the moisture-content, determined by the oven-drying method, is higher than for other dried-milk products; it amounts to 9-12 percent. The ground material keeps well when properly packed in paperlined barrels, but the unground cake tends to develop moulds quickly."

Flavor. The flavor of dry whey solids varies with the acidity of the whey and the process by which it was obtained. Usually the flavor is pleasantly sweet with a slight subdued acid reaction as an aftertaste. This flavor may change upon storage to a stale, slightly sour flavor, which is accompanied by a marked browning of the product. Samples of commercial dried whey made by concentrating the whey, allowing the concentrate to become plastic, then oven drying the pelleted plastic were stored at room temperature for three years. During that period the product underwent a decided change in flavor and color. The color changed within a year from a light yellow to a dark brown and the odor from a pleasant whey odor to that probably best described as that of corn-gluten feed or that of roasted cereal grains. To some it suggested a poor grade of coffee or chicory. Doob and co-workers (1942) observed that dried whey darkened more readily during storage and to a higher degree than dried milk. Ramsdell and Webb (1938) noted that even in the sweetened condensed form, whey darkened in color as the temperature and time of storage was increased but the brown color did not become excessively dark during two or three months storage at room temperature.

This browning or darkening of the color and the associated off-flavor appear to be the chief organoleptic defects of dry whey.

DRY ICE CREAM MIX

Dry ice cream mix is a comparatively new dry dairy product. Upon addition of the correct percentage of water, the product yields a mix of 10 percent fat, 15 percent sugar and 36 percent total solids. It must contain, in the dry form approximately 27 percent fat and 40 percent sugar. Such a product yields first a pronouncedly sweet taste reaction followed by a clean, rich, pastry-like taste. The chief defect of the product seems to be that of fat oxidation which results in the tallowy flavor. This tallowy flavor is not unlike that which may be noted sometimes in dry whole milk. Definite standards have not as yet been worked out for this product.

MALTED MILK

According to the Federal Standard malted milk is the product made by combining whole milk with the liquid separated from a mash of ground barley malt and wheat flour, with or without the addition of sodium chloride, sodium bicarbonate, and potassium bicarbonate, in such a manner as to secure the full enzymic action of the malt extract, and by removing water. The resulting product contains not less than 7.5 percent of butterfat and not more than 3.5 percent of moisture.

Each pound of malted milk contains the total solids of approximately 2.2 pounds of whole milk. If a whole milk testing 13 percent total solids were used in malted milk manufacture, the final product then would contain only about 29 percent milk solids. Thus it appears that the term "malted milk" is a misnomer. In reality malted milk is a grain product, being made from malted wheat and barley flour. Since malted milk is so widely used it is essential that the dairy products judge be familiar with some of its properties.

Flavor. Malted milk, being composed in large part of maltose and dextrose, has a definitely sweet taste. In addition it has a distinct flavor of malt, which is derived from the barley during the mashing process. This malty flavor is much desired in malted milk. The flavor defects in malted milk are rare but the following have been encountered:

1. Lack of malt flavor. The lack of a pronounced malt flavor appears to be rather common in malted milk. Such malted milk carries the desired sweetness but has no other particular flavor appeal.

2. Tallowy. The tallowy oxidized flavor defect is rare in malted milk. Nevertheless, tallowiness has been encountered in the product. This flavor defect in malted milk has the same flavor characteristics as tallowy dry milk.

On the keeping quality of malted milk Hunziker (1935) states:

> "Malted milk is as yet the only milk powder containing whole milk that will keep indefinitely in any climate. Those who have subjected the manufacture and marketing of malted milk to careful study hold that the keeping quality of malted milk is due to the fact that the fat globules in this product are surrounded by a coating or envelope of gluten, sugars and salts which protect the fat against the deteriorating action of air.
>
> "The use of whole wheat flour, while originally a survival of The Horlick's Food, from which malted milk was developed, may also be responsible, in part at least, for the good keeping quality of malted milk. Its large amount of gluten may assist in furnishing an effective coating for the protection of the fat globules. Experiments made with flour of other cereals gave results that did not warrant their use in the place of wheat flour.
>
> "Again, it was experimentally found that malted milks made by more mixing of the required ingredients, also becomes stale and tallowy, and that the only product that has permanent keeping quality is that, in the manufacture of which scientific use is made of the action of enzymes and similar ferments."

Texture. Malted milk is usually coarse and grainy unlike the texture of spray dried milk or of that of nonfat dry milk solids. The product has a great affinity for water and when exposed to moist air it first becomes sticky and then cakes. Hunziker (1935) states:

"As previously explained, malted milk is of high hygroscopic nature. It readily absorbs moisture and becomes wet, soft and gummy. To prevent this malted milk must be protected against humid air by keeping it in moisture-proof containers. However, even in this gummy condition the product does not appear to noticeably change in flavor."

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Review Questions

1. Name the two main processes by which dry milk is made.
2. How can dry milk made by the spray process be distinguished from that made by the drum process?
3. Define nonfat dry milk.
4. What are the approximate percentages of fat in nonfat dry milk and in dry milk solids?
5. Name the six items upon which Federal Standards for nonfat dry milk and dry whole milk are based.
6. What ratio of solids to water should be used in reconstituting nonfat dry milk solids for taste studies?
7. Name the chief flavor defects of dry whole milk.
8. What are the chief texture defects of dry whole milk?
9. Why is a rancid flavor almost never encountered in drum-dried whole milk solids?
10. What flavor defect is often associated with age darkening of nonfat dry milk solids?
11. What is the cause of caking of nonfat dry milk solids?
12. Will the caking of nonfat dry milk solids occur more frequently in spray- or in roller-process powder? Explain.
13. Compare the texture of malted milk with that of spray-process dry whole milk.
14. How does the hygroscopicity of malted milk compare with that of drum-dried nonfat dry milk solids?

CHAPTER XIII

DAIRY PRODUCTS JUDGING CONTESTS AND CLINICS

The very nature of dairy products makes dairy products judging contests and clinics imperative, if a high-quality level is to be maintained. Dairy products, not unlike other perishable food products, gradually change with age. Physical, chemical and bacteriological factors or a combination of these factors contribute toward these changes. The rapidity with which these changes take place depends upon many conditions, such as temperature of storage, exposure to light and air, contact with the container, chemical reaction, micro-organisms and enzymes present, the quality of the raw product used and the skill and control exercised in processing. Manufacturers and distributors know that dairy products must reach the consumer in good condition and contain all the good qualities that were intended to be in them if these products are to meet and hold consumer preference.

Some manufacturers of dairy products develop a super quality complex for their own products even though they are not of high quality. This no doubt is due to the fact that they do not compare their products with those of their competitors. They also neglect to discover how the consumers rate their products. In order to make quality comparisons of competitive dairy products and to get an appreciation of consumer preferences, the authors suggest educational dairy products scorings or grading schools which are sometimes referred to as dairy products clinics. These clinics may be conducted in many ways according to the results sought.

Objectives

A manufacturer may desire to compare his product with other similar competitive dairy products sold in the area. In this case he would purchase a like sample of the different brands of the dairy product sold in the area and compare them with his product. The main object of this kind of a clinic is to compare qualities and to study qualities of competitive brands that are enjoying wide consumer acceptance.

A group of makers of a certain dairy product may want to meet and compare qualities of their products. In this case a competent judge of the product generally takes charge, carefully scoring the product and constructively criticizing it to the group. To avoid competitive prejudice, the scoring can be done in such a way that no one present knows the identity of any of the samples other than his own.

In order to acquaint consumers with the qualities of dairy products, consumers' educational clinics may be held. A group of consumers may be assembled and the desirable quality properties and the defects of dairy products explained to them. A number of samples may be examined organoleptically and the physical factors pointed out to them by an experienced judge. The judge can also instruct the consumers in what to observe and what to avoid in purchasing dairy products for use in the home.

Student dairy products' judging contests have proved very helpful in training future dairy plant operators and future dairy products' judges. Graduates of dairy schools who have had training in judging are better fitted for a responsible position in the industry. They understand more clearly the problems involved in improving the quality of dairy products and have a clear conception of the quality standards of the different grades of dairy products on the market.

MARKET MILK SCORING SCHOOLS

Market milk scoring schools aid materially in educating milk producers and milk consumers in regard to both the desirable and the undesirable qualities of market milk. Milk is consumed in some form in every American home. Much has been done by interested agencies to make milk more wholesome. Conversely, not much has been done to educate market milk dealers and market milk consumers in regard to the organoleptic qualities and other factors that go to make up a satisfactory market milk supply which is conducive to increased consumption.

Kind of contest. There are two kinds of market milk scoring contests, namely, "prepared" and "surprise" contests. A contest in which the samples are selected and entered by the exhibitor for the scoring is known as a "prepared" contest. A contest in which the exhibitor does not know when his sample is to be collected and entered into competition with samples from other

distributors in the area is known as a "surprise" or "pick up" contest.

The "prepared" contest may measure only the ability of the exhibitor to select milk of good flavor quality and process and package it in such a manner that the product will merit a high rating on the milk score card. The sample submitted to the contest may not be representative of the daily plant output and may not indicate the average quality of the milk delivered to the consumers. Such a contest, however, does educate the exhibitor as to the requirements and possibilities of high quality milk production. The "surprise" or "pick up" contest measures more nearly the quality of the product which the consumer is receiving from his distributor. The "surprise" contest is recommended over the "prepared" contest because it has much more educational value for both the distributor and the consumer.

Collection of samples. Only quart samples should be collected. Samples for the "surprise" market milk contest can be collected from the delivery trucks, from stores or from the refrigerator of the plant distributing the milk. The collector should be sure the samples represent the milk that is to be delivered on the day collected. Milk from the previous day should be avoided, as it does not represent the fresh supply. In every case the milk collected for the contest should be of the same age in order to put the samples on an equal age basis. Immediately after collection, the samples should be put in a refrigerated storage room until they are examined. Each sample should be properly numbered or coded by a small tag attached to the neck of the bottle by a string or rubber band. A perforated, duplicate-numbered tag is well adapted for this purpose as no mistakes can be made in the identity of the samples. Marking the bottle with a wax pencil or writing on the cap is unsatisfactory as the markings are often illegible and are not permanent. Such practice involves a double entry thus increasing the chance for error in identification. All identifications on the cap and on the bottle should be obscured so that no one other than the superintendent of the contest, will know the identity of the samples. After the samples have been arranged in order and the identification of the samples recorded by the superintendent, the milk is ready to be examined.

Order of Examination

The evaluation of the items on the score card should be made in the order named in Chapter V and all the samples should be

scored according to the standards given in that chapter and in the following order.

1. Temperature. If the outside of the container is cold to the feel when the sample is entered or picked up for the contest, indicating that the milk in it was properly cooled before delivery the sample is given a full value of 5 points on temperature. In case the container is warm to the feel when entered or picked up for the contest, indicating that the milk in it was not properly refrigerated the sample is given a score of 0 on temperature.

2. Container and closure. If the milk is homogenized it should be examined first for sediment. The container should be examined to see if it is clean, free from defects and adequately filled. The closure should be examined to see if it gives sufficient protection to the contents of the bottle. Full value is generally given to the closure if it fully meets the requirements of the agency supervising the milk supply in the area.

3. Bacteria count. The next step is to plate the milk for bacteria count. This should be done in accordance with the directions given in Standard Methods for the Examination of Dairy Products.

4. Sediment test. After the milk is plated for bacteria count, the sediment test should be made on each sample in accordance with the directions given in Standard Methods for the Examination of Dairy Products. The cotton discs containing the sediment of each sample should be carefully preserved so they will not become contaminated with dust or lint. This may be done by covering with cellophane or placing them in a clean petri dish. The sediment discs should be scored in accordance with directions given in Chapter V.

5. Evaluation of flavor. From the remainder of the sample ascertain the flavor. The proper evaluation and interpretation of flavor in each sample is the most important phase in conducting an educational market milk scoring school. While the other factors considered have a definite bearing on the wholesomeness of market milk, flavor is the factor directly responsible for consumer acceptance. The palatability of milk makes the greatest consumption appeal. Consumers demand safe milk delivered in an attractive, clean, protected package, but in addition, they desire a product that is pleasing to the taste.

The contest is of the greatest educational value when the flavor of each sample is evaluated, compared and discussed by an experienced milk judge at a meeting of the exhibitors. This can be done without embarrassment, as each sample is identified by number only. Each entry should be sampled not only by the judge but also by those in attendance. After each sampling, the flavor should be discussed and possibly compared with some of the samples previously scored. If a flavor defect is present, its intensity, seriousness, and possible prevention should be considered. The judge should then put a flavor score on the sample and give his reason for the numerical score given. In addition to the numerical score, he should classify the flavor of each sample as excellent, good, fair, poor or bad, according to the classification given on the back of the score card for milk and cream (Chapter V).

Comparing the scores. After each sample has been scored and the merits of its flavor discussed, the flavor, sediment, temperature and container and closure scores should be added and displayed on a chart or blackboard by number, as indicated in Figure 93, so they can be seen by those attending the meeting. The display of the scores of each sample will enable each milk distributor present to evaluate the score of his sample in comparison to the scores of each of the other samples in the class. A discussion of the defects encountered by the judge and how to eliminate these defects will prove very helpful in improving the milk supply of the area. In addition to a general discussion, the judge can give confidential advice to each distributor on how to improve his own milk supply.

EDUCATIONAL BUTTER SCORING CONTESTS

Educational butter scoring contests are generally useful for comparing exhibition butter made for scoring contests, to examine commercial butter for quality deterioration, and to examine the score and grade of butter from different plants that are in competition.

Kind of contest. The kind of contest will depend primarily on the information desired. Butter is sometimes made from carefully selected cream under very carefully controlled conditions and entered in competition at dairy products exhibits where it is scored by expert judges on the basis of desired perfection. Butter so entered is known as "exhibition" butter and such a contest is

Date ....

Place ....

Market Milk Score Report

Sample No.	Flavor — 45		Bacteria — 35		Sediment — 10	Temperature — 5	Container and Closure — 5	Total Score	Rank	Rating
	Score	Criticism	Count	Score	Score	Score	Score			

Figure 93

Date ....

Place ....

Butter Score and Grade Report

Sample No.	Flavor — 45		Body & Texture — 25		Color — 15		Salt — 10		Package — 5		Total Score	U. S. Grade
	Score	Criticism	Score	Criticism	Score	Criticism	Score	Criticism	Score	Criticism		

Figure 94

known as an "exhibition contest." The judges' scores, criticisms and comments on exhibition butter are generally useful in ascertaining the quality of butter that can be made if high quality cream is procured and carefully processed. The high scores on butter made by some buttermakers are a challenge to competing contestants and to the butter industry to strive to reach greater quality perfection.

There is another kind of an educational butter scoring contest, known as a "cold storage" contest, which is generally useful in testing the ability of the buttermaker in making a high quality product that will keep well in cold storage. Butter entered in a "cold storage" contest is carefully judged by expert butter judges, when fresh, and after storage for about six months at 0° F. (−18° C.). The buttermaker is not only rated on his ability to make good butter but also on the keeping quality of his product under storage conditions.

A "pick-up" or "surprise" butter grading or scoring is one in which commercial butter made from regular run cream is assembled unbeknown to the buttermakers. The real purpose of this kind of a contest is to determine the quality of the butter made by each plant and to offer suggestions for improvement. This kind of a contest is also generally useful to check the quality deterioration of butter from the time it is made to the time it is sold and has also been used to determine the keeping quality of butter in the commercial and in the home refrigerator.

Collection of samples. Samples of butter made for exhibition contests are entered in compliance with rules and regulations issued by the superintendent of the contest. Each sample is generally accompanied by a manufacturing record which contains all the data necessary to place the butter into its proper class. There are generally two classes of butter entered in an exhibition contest; butter made by using culture, known as "culture butter," and butter made without using culture, known as "non-culture butter." Occasionally a third class of butter is entered, that made with or without culture from the regular daily run of cream. Such butter is generally designated as "commercial butter." Samples for an exhibition contest are sent in to the contest voluntarily by buttermakers who wish to compete in the different classes. If the purpose of the scoring is to compare commercial stocks of butter or to compare the scores of certain

lots of butter when fresh with those after a holding period, then the samples are collected from a representative supply upon which scores or grades are desired.

Samples for a "pick-up" or "surprise" contest are collected unannounced from regular representative commercial butter held under the same conditions as it is reaching the consumer. The samples for a "cold storage" contest are entered in compliance with rules and regulations very similar to those for the "exhibition" contest.

Size and marking of samples. Exhibition butter is generally displayed in wood or paper boxes or tubs ranging from 10 to 68 pounds net weight. Samples within this size range enable the judge to procure a sample plug of butter from the center portion of the sample which is free from possible surface contamination or contamination from the sides or bottom of the container. One-pound prints are generally used for commercial butter samples unless special provision is made for taking samples of each churning, in which case a small 5-pound wood or paper box has proved suitable. A one-pound print is the smallest sample that should be taken to represent a churning. It is too difficult to get a true representative sample from samples smaller than a one-pound print.

After the samples are collected they should be properly marked by number and this number recorded as a permanent record. The identification number should be known to no one except the superintendent of the contest.

Scoring the samples. The butter should be scored by a competent judge as described in Chapter VI. Before being scored, the samples should be arranged, tempered, and placed in order in a suitable room. As each sample is judged the resulting scores should be tabulated on a form as suggested in Figure 94.

Reporting the results. The results should be reported according to the use to be made of them. The results of an exhibition contest should be sent to each exhibitor giving him complete detailed results on the scoring of his sample with constructive criticism for the improvement of his product. It is generally customary to publish the name of the exhibitor, the score totals of products in order of rank for all entries of butter scoring 92 or above.

The scores of samples of commercial butter entered in a "pick-up" or "surprise" contest may be reported according to the use to be made of the results. If the purpose of the contest is to educate the buttermakers, then the buttermakers are generally invited to score the samples, which are identified by number, along with the judge. Each sample is criticized as the scoring proceeds. After all the samples are scored the results are tabulated on a chart or blackboard in order of score rank as indicated in Figure 94. Each buttermaker having an entry is given confidentially the number of his sample which enables him to derive the maximum benefit from the general discussion of the flavor and workmanship defects without embarrassment.

In case commercial butter samples are scored to determine the quality of butter made in the state or in the community, the results are generally mailed to the competing plants. In addition to the score of the sample, suggestions for quality improvement for each plant are generally enclosed. Sometimes samples of butter made by plants are picked up in commercial channels to see how the quality is standing up after the butter leaves the plant. A check on several samples each year, scored when fresh and after being held in storage for a time or after the butter has been handled through trade channels, affords valuable data for the plant which may be used to improve their manufacturing and handling practices.

CHEESE CLINICS

Due to the bacteriological, chemical and physical changes that occur in cheese when it is aged and the possible mold contamination which may result when it is stored, the examination of cheese for quality is quite different from the quality examinations of other dairy products. Some varieties of cheese are consumed when fresh and are not considered at their best if bacteriological and/or chemical changes have occurred within them. Other varieties are not considered a finished product until they have undergone considerable bacteriological and chemical changes which take place during aging or ripening. In some states cheese is graded and branded when it is young. Some cheddar cheese is graded and sold on grade ten days after it is made. Therefore, in order to evaluate properly the quality of cheese, the judge must be able to determine the quality of young cheese as well as that of the aged product. The judge must also be capable of judg-

ing a cheese at various stages of age development and determining its potential quality possibility if it is aged under prescribed conditions.

Experience in cheesemaking is a great asset to a cheese judge. By actually working with cheese he learns the importance of the different steps in the making process and the effects on the finished cheese if these steps are not properly executed. Cheese clinics at which the flavor quality, physical properties and finish are carefully examined have proved to be a valuable aid in improving the quality of cheese.

Size and arrangement of samples. The samples to be examined should be sufficiently large so that the flavor is not influenced by surface contamination. For soft cheeses which are generally consumed while fresh, a pint sample will suffice, providing there is no surface contamination. For cheese which are to be aged, an entire cheese, regardless of style or weight, should be taken as a sample. The samples should be numbered and placed in order in the class. Paper packages of soft cheese may be satisfactorily marked with pencil. The hard type cheese should be marked in such a manner so as not to damage the paraffin or other coating, which helps protect the cheese from drying and mold contamination. Tying a shipping tag to each cheese by means of a string has proved satisfactory. Any method used in marking should not interfere with the outside covering of the cheese.

Examining the samples. The samples should be carefully examined according to the methods described for each kind of cheese in Chapter VII. The kind of report made on each sample will depend on the use to be made of the data procured. If the cheese is being examined to educate the cheesemakers as to the quality of the cheese the findings on each sample should be reported on the score card given in Chapter VII. In order that the cheesemakers derive the maximum benefit from the scoring, it is recommended that the clinic be held on a specified date at which time the cheese will be scored and criticized in the presence of the cheesemakers who made the cheese. If this is done, each cheesemaker should be given the number of his sample so he can compare his product with the other samples in the class. For the information of those attending the clinic, a summary of the scores of all the samples should be tabulated on a blackboard or chart in order of quality rank on a form such as the one suggested in Figure 95. After the scoring, those in attendance no

Date ....

Place ....

Cheddar Cheese Score and Grade Report

Sample No.	Flavor — 45		Body & Texture — 30		Finish — 15		Color — 10		Total Score	Rank	U. S. Grade
	Score	Criticism	Score	Criticism	Score	Criticism	Score	Criticism			

Figure 95

Date ....

Place ....

Ice Cream Score Report

Sample No.	Flavor — 45		Body & Texture — 30		Bacteria — 15		Melting Qualities — 5		Color & Package — 5		Total Score	Rank	Rating
	Score	Criticism	Score	Criticism	Count	Score	Score	Criticism	Score	Criticism			

Figure 96

doubt will desire information on how to correct the defects found in the different samples. A good practical cheese judge can do much to improve the quality of cheese by explaining why the different defects occur and how they can be remedied.

ICE CREAM CLINICS

Frequently ice cream manufacturers desire to have their ice cream examined critically to see how it compares with competitors' samples, or measures up to standards of perfection. For this purpose ice cream clinics are held, usually in connection with a dairy technology conference where ice cream manufacturers may gather and actually compare the ice cream samples incognito, the samples having been sent in previously for the clinic. Such clinics are very helpful. The results of the study provide a guide for the improvement or maintenance of the quality of the product. Since the samples are numbered to eliminate possibility of identification of ownership, the manufacturers welcome the opportunity of examining the samples and studying the data obtained on them. These data, with the manufacturer's identifying number checked, are sent to each manufacturer some time after the clinic so the manufacturer may have an opportunity to study the data on his ice cream at leisure.

Since scores or grades are given, the competitive spirit, common to a contest, is present and, furthermore, there is usually a yearning for facts about the ice cream. Thus, the clinics prove to be of real educational value.

After the samples of ice cream have been carefully examined, the scores can be entered on the ice cream score report suggested in Figure 96. A copy of the scores, giving the rank in the class and the general rating of each sample, can be sent to each manufacturer having an entry. By checking only the sample belonging to each manufacturer, he can see how his sample ranked in the class without knowing the owners of the other samples.

In making a critical examination of vanilla, chocolate and strawberry ice cream, Combs (1946)* used the score sheets shown in Figures 97, 98 and 99.

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*Combs, W. B. 1946. Defects in Ice Cream and How to Avoid Them (Abst. 7th. Ann. Dairy Plant Conf., N. Dak. Agr. Conf., Feb. Mimeo.)

VANILLA ICE CREAM

SAMPLE	COMPOSITION	BACTERIAL COUNT
No.	Total Solids .... %	.... per cc.
Date	Fat .... %	

SAMPLE RATING

	Flavor	Body and Texture	Color	Melting Quality
Excellent	......	....	......	......
Above average	......	....	......	......
Average	......	....	......	......
Below average	......	....	......	......
Poor	......	....	......	......

FLAVOR CRITICISMS

.... Old butter
.... Old cream
.... Condensed milk
.... Dry milk
.... Old ingredient flavor
.... High acid
.... Rancid
.... Unclean
.... Cooked
.... Garlic
.... Metallic
.... Neutralized
.... Egg powder
.... Gelatin
.... Storage
.... Salty
.... Unnatural flavor
.... Too high flavor
.... Lacks flavoring
.... Lacks fine flavor
.... Lacks sweetness
.... Too sweet

BODY AND TEXTURE CRITICISMS

.... Buttery
.... Coarse
.... Crumbly
.... Fluffy
.... Gummy
.... Icy
.... Sandy
.... Soggy
.... Gelatin lumps
.... Weak

COLOR CRITICISMS

.... Unnatural
.... Too much
.... Too light
.... Uneven

MELTING QUALITY

.... Curdy
.... Does not melt
.... Spongy
.... Wheys off
.... Watery

Figure 97 — Grading Record Used by the University of Minnesota in Grading Vanilla Ice Cream.

JUDGING SCORE SHEET FOR CHOCOLATE ICE CREAM

Sample No. .... Fat per cent ....

Total Solids per cent .... Bacteria per cc. ....

SAMPLE RATING

	Flavor	Body and Texture	Color	Melting Quality
Excellent	......	....	......	......
Good	......	....	......	......
Average	......	....	......	......
Below average	......	....	......	......

FLAVOR CRITICISMS

I. Flavor Due to Chocolate Products:

1. Pronounced cocoa flavor ... 2. Lack of chocolate flavor ....
3. Pronounced liquor flavor ... 4. Bitter or harsh flavor .....
5. Lacks sweetness .... 6. Too sweet a flavor ....
7. Fudge or candy flavor ..... 8. Burnt or scorched flavor ...
9. Caramelized flavor .... 10. Powdery flavor ....
11. Unnatural flavor: a. Cinnamon .... b. Maple .... c. Salty .... d. Malt .... e. Butterscotch .... f. Licorice ....

II. Flavor Due to Milk Products:

1. Old ingredient flavors: a. Butter .... b. Cream .... c. Egg .... d. Powder .... e. Condensed ....
2. Unclean ...... 3. Cooked or heated ...... 4. Sour or high acid ....5. Neutralized .... 6. Unnatural ....

BODY AND TEXTURE CRITICISMS

1. Crumbly (short grain) ...... 2. Crumbly (rolly or dry) ......
3. Powdery (undissolved cocoa or liquor) .... 4. Icy ....
5. Grainy .... 6. Fluffy .... 7. Weak ....
8. Syrupy (lacks firmness) .... 9. Melting quality: a. Curdy ..... b. Does not melt ..... c. Spongy ..... d. Wheys off .....

COLOR CRITICISMS

1. Desirable (natural light chocolate brown to natural dark chocolate brown)
....
2. Yellowish ...... 3. Grayish .... 4. Black ....
5. Pinkish .... 6. Foreign material ....
7. Specks (cocoa) .... 8. Specks (green) ....

Figure 98 — Grading Record Used by the University of Minnesota in Grading Chocolate Ice Cream.

STRAWBERRY ICE CREAM

SAMPLE	COMPOSITION	BACTERIAL COUNT
No.	Total solids .... %	.... per cc.
Date	Fat .... %	

SAMPLE RATING

	Flavor	Body and Texture	Color	Melting Quality
Excellent	......	....	......	......
Above average	......	....	......	......
Average	......	....	......	......
Below average	......	....	......	......
Poor	......	....	......	......

FLAVOR CRITICISMS

.... Old butter	.... Unclean	.... Storage
.... Old cream	.... Cooked	.... Salty
.... Condensed milk	.... Garlic	.... Unnatural flavor
.... Dry milk	.... Metallic	.... Too high flavor
.... Old ingredient flavor	.... Neutralized	.... Lacks flavoring
.... High acid	.... Egg powder	.... Lacks fine flavor
.... Rancid	.... Gelatin	.... Too sweet
.... Oxidized		.... Lacks sweetness

BODY AND TEXTURE CRITICISMS

.... Buttery	.... Fluffy	.... Sandy
.... Coarse	.... Gummy	.... Soggy
.... Crumbly	.... Icy	.... Weak
		.... Gelatin lumps

COLOR CRITICISMS	MELTING QUALITY
.... Unnatural	.... Curdy
.... Too much	.... Does not melt
.... Too light	.... Spongy
.... Uneven	.... Wheys off
	.... Watery

CRITICISMS OF STRAWBERRIES

.... Icy	.... Too sweet	.... Sandy
.... Stale	.... Lacks sweetness	.... Calyx present
.... Rancid	.... Fermented	.... Too light in color
.... Bitter	.... Greasy	.... Too dark in color
.... Sour or acid	.... Hay flavor	.... Brown
		.... Green

Figure 99 — Grading Record Used by the University of Minnesota in Grading Strawberry Ice Cream.

STUDENTS' DAIRY PRODUCTS JUDGING CONTESTS

A college students' international contest in the judging of dairy products is sponsored by the American Dairy Science Association, the Dairy Industry Supplies Association and the United States Department of Agriculture. Regional contests are sponsored by the Eastern, Southern and Western Divisions of the American Dairy Science Association. The international contest is generally held at the time and place of the Dairy Industries Exposition. The regional contests are generally held at the time and place of divisional dairy science conventions. Additional contests are also held in some of the agricultural departments of the high schools throughout the United States. Dairy products judging contests are held to aid students interested in dairy products in becoming more proficient in judging and evaluating the qualities of these products. Dairy products judging contests offer the student the opportunity to put his training to a test. The results of judging in a contest will not only show how far he has progressed, but will furnish an initiative for further study. Students who are well trained in judging are in a position to be of greater service to the dairy industry in that they are more ably prepared to improve the quality of dairy products through the detection of flavor defects which often meet with the consumers' disapproval. These contests also aid materially in training the future dairy products judges to serve the industry. Thus, the contest furnishes the student an opportunity to:

1. Evaluate his training, knowledge and experience in the judging of butter, cheese, milk and ice cream.
2. Observe the quality of dairy products in other sections of the country and to note the standards of quality recognized by competent judges.
3. Put to test his ability to arrive at conclusions within a definite period of time and under a new environment.
4. Meet similarly trained students from other colleges in wholesome competition and in a friendly environment; and gain the educational benefits of travel.
5. Obtain an out-of-the-classroom vision of the size and scope of the dairy industry; meet leaders in the industry; and gain inspiration by a view of Dairy Industries Expositions.
6. Kindle the desire to lead in a chosen field.

Organization of the contest. The contest is organized and supervised under the direction of a superintendent. He is responsible for the selection and arrangement of the dairy products samples, the conduct of the students while they are judging, the correction of the papers, and the tabulation of the final scores. When the judging contest is underway the coaches of the teams are not allowed to converse with members of the team or enter the judging room until after the contest is over. Codes are used to identify the contestants' score cards so that the graders will not know the identity of any of the contestants.

Rules for the contest. The superintendent is guided by a set of rules. Rules for the Collegiate Students' International Contest in the Judging of Dairy Products will be found in the Appendix, together with a sample of a score card for each product judged. These rules and score cards were compiled by the Committee on Judging of Dairy Products, American Dairy Science Association. The rules are revised from time to time so the present rules are a result of many years of trial and revision. Likewise, the score cards shown in the Appendix have been studied, changed and brought up to date to conform with the findings of the committee.

Selection, judging and marking of the products. The products judged by the students are generally pasteurized milk (Figure

Figure 100 — Retasting Samples of Milk at the Close of a Judging Contest. (Courtesy Dairy Industries Supply Association.)

100), creamery butter, Cheddar cheese, and vanilla ice cream. The samples are selected by the official judges under the direction of the superintendent of the contest. An effort is made to get products varying in quality so that the student judge may encounter many of the defects which are likely to occur in the various grades of products.

The products, which have been previously judged by official judges some time before the contest, are generally checked by a committee of coaches just before the students examine them. The samples are marked so as to cover up any previous identity. Thus the student judge must consider each sample entirely on its merits.

Awards. In order to stimulate interest in the contest, prizes are generally awarded to the high ranking men in each product, the high team in each product, and the high ranking men and team in judging all products. These awards are generally presented at a banquet or other public gathering (Figure 101). The object of these awards is to arouse enthusiasm and to enhance interest in the student to further his study of the judging of dairy products.

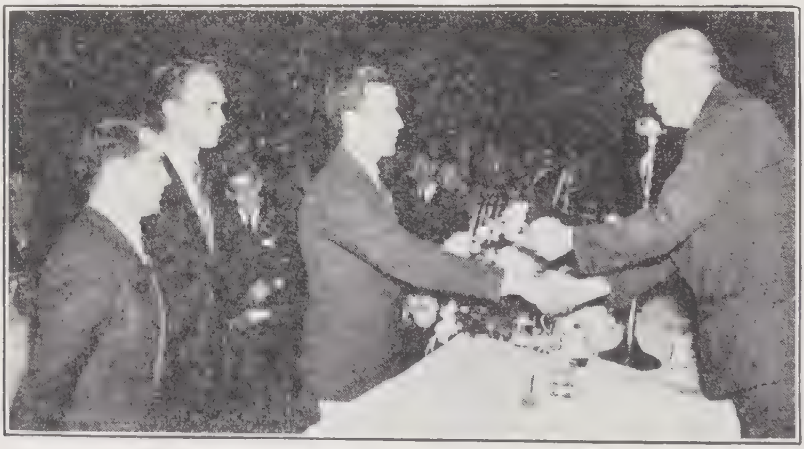

Figure 101 — A Highlight in the Announcement of Winners of the Collegiate Students' International Contest in the Judging of Dairy Products is the Presentation of Awards to the Individual Winners in the Judging of Dairy Products.

Review Questions

1. Why is the "surprise" market milk contest considered to be of more educational value than the prepared contest?
2. Explain how a "pick-up" market milk contest is conducted.
3. Name the three kinds of butter scoring contests.
4. What kind of a butter scoring contest would you recommend, if the objective was to improve the quality of butter made in the dairy plants of your state?
5. Explain how a "cold storage" butter contest is conducted.
6. What is a cheese clinic and why is it generally useful to the cheese industry?
7. Explain how an ice cream clinic is conducted.
8. Give three objectives of students' dairy products judging contests.
9. Outline the manner in which the students' dairy products judging contest is organized and supervised.

APPENDIX

RULES FOR COLLEGIATE STUDENTS' INTERNATIONAL CONTEST IN JUDGING DAIRY PRODUCTS*

1951

The Collegiate Students' International Contest in the Judging of Dairy Products is an annual contest among college students — teams and individuals — in judging the quality and market grade of creamery butter, Cheddar cheese, pasteurized milk, and vanilla ice cream.

This contest is sponsored by the American Dairy Science Association and the Dairy Industries Supply Association, Inc., and is under the direct supervision of the United States Department of Agriculture, a member of which department is the superintendent of the contest.

Eligibility of Contestants

Any undergraduate student of a land-grant state agricultural college or of a college of corresponding rank, who: (1) is regularly matriculated in a four-year agricultural course, or has completed at least 10 semester hours in dairy technology, (2) has taken not less than 36 weeks undergraduate work in that institution, (3) has never taken part in the Collegiate Students' International Contest in the Judging of Dairy Products, (4) has never acted as an official judge of dairy products, and (5) has not taught the manufacture of or the judging of dairy products, may enter as a member of a team. Students who are not members of a team are not eligible to enter. Three students from any one college or university shall constitute a team.

Rules Governing Contest

1. All entries must be received at the office of the Dairy Industries Supply Association, Inc., 1108 16th St. N.W., Washington 6, D. C., not later than two weeks previous to the date of the contest.

Regular entry forms will be mailed by the superintendent at least one month prior to the contest to the coach of the dairy products judging team and or to the professor of dairying or dairy manufacturing in each state or provincial agricultural college.

2. Each institution eligible to participate in this contest may enter a team consisting of three eligible students of that institution.

3. Each contestant shall report to the superintendent of the contest at such time and place as may be announced. He will then be assigned a number and given such instructions as the superintendent may deem necessary.

4. The contestants shall be divided into four groups, each consisting of not more than one member of each team.

5. No contestant shall wear any uniform, college colors, college badge, or college pin which may in any way reveal his identity or the identity of the college which he represents.

6. No contestant shall take any notebook, writing paper, or writing board into the contest. He shall provide himself with a black lead pencil. Ink shall not be used in recording scores and criticisms.

7. While the contest is in progress or during the 5-minute rest period there shall be no communication between the contestants or between contestants and any other person, except as directed by the superintendent or his representative, and then only in the presence of the superintendent or his representative. There shall be no intermingling of groups or communication between groups while the judging is in progress or during the rest period.

8. Reporters, photographers, and others, except the contestants, the superintendent, and his assistants, shall be excluded from the place of scoring while the contest is in progress. Exceptions to this rule shall be made by the superintendent to promote the good of the contest.

9. Any contestant violating any rule will be debarred from the contest. If a member of any team is debarred because of violation of rules, that team will be debarred from the team contest. The remaining members of the team may compete for individual prizes.

10. Each contestant, at the beginning of a judging period, will be given a contest score card on which he shall record in the proper place his scores and criticisms and the "contestant number" assigned to him. At the expiration of the allotted time he shall return it to the superintendent or assistant in charge. Contestants will also be given memorandum cards on which they may keep, for their own use, a record of their scores and criticisms.

11. Each contestant shall score and criticize, by writing in his score and by making check marks (✓) in the proper places, 10 samples each of creamery butter, Cheddar cheese, pasteurized milk, and vanilla ice cream. Each contestant will total all items for each sample thus scored and criticized to check his own scoring.

12. Forty minutes are allotted for scoring each product. A 10-minute notice prior to the close of a scoring period shall be given. A 5-minute rest period shall be allowed between the judging of each product.

13. The products shall be scored and criticized on the basis described on pages 427 to 430.

14. A criticism shall be check-marked (✓) on the card whenever the score of any item such as flavor or texture is cut to the extent specified on the score cards shown on pages 427 to 430.

15. Each contestant shall furnish his own short butter and cheese trier. The long butter triers shall not be used.

Superintendent of Contest

It shall be the duty of the superintendent of the contest to determine that all rules and regulations governing the contest are duly carried out and to see that the contest is conducted with fairness and justice to all.

He shall have a sufficient number of assistants and clerks to help him in conducting the contest.

The members of the Dairy Products Judging Committee of the American Dairy Science Association shall be present to: (1) assist the superintendent in determining that the products are scored according to the rules; (2) aid in starting the contest; (3) supervise the grading of the contestant cards; and/or (4) summing the contestant grades if such assistance is desired.

He shall direct the contestants as to the products to judge, time to commence work, and time to stop. He shall notify the contestants 10-minutes prior to the close of a judging period.

After instructing the contestants in a body regarding the contest, the form in which to prepare the scores and criticisms, etc., he shall say nothing to any contestant as to the method for a contestant to follow in scoring.

He shall designate a member of the Committee on Judging Dairy Products of the American Dairy Science Association to be general supervisor of the card-grading committee and to be custodian of the contestant cards during the grading period.

Before passing the contestant score cards to the supervisor of the card grading committee he shall direct that the "contestant number" be

covered with a suitable seal so as to conceal the identity of the contestant and mark the card with a code letter and number.

He shall have charge of all records and shall have all ratings totaled and tabulated. He shall deliver the results of the contest to the executive secretary of the Dairy Industries Supply Association, Inc.

He shall decide all questions which may arise in connection with the interpretation of the rules governing the contest, and may make temporary rulings to facilitate the working of the rules in force at the beginning of the contest.

Assistants and Clerks. An assistant shall have charge of each group of contestants. Each contestant in his group shall remain in his presence the entire time the contest is in progress. In case of emergency, absence shall be directed by the superintendent. He shall see that there is no intermingling of groups during the rest periods.

Clerks shall be provided for the card-grading committee.

Selection, Preparation, and Marking of Products

The products shall be provided by the Dairy Industries Supply Association, Inc., and shall be recruited from various sections of the United States wherever possible.

The official judge of each product named by the superintendent of the contest shall select samples of creamery butter, Cheddar cheese, pasteurized milk, and vanilla ice cream respectively which in his judgment will make a representative scoring contest for each product. A sufficient number of samples shall be available so that in case of disagreement among the judges other samples may be substituted. Identical samples may be used in the contest. "Cheddar" and "Daisy" or "Twin" shall constitute the style of cheese used in the majority of samples. "Longhorn" and rindless (cured-in-package) cheese may be included. Nothing artificial shall be added to any sample which will affect its flavor or in any other way change its score. All samples shall be of such quality as to be salable, commercial products.

The packages shall be numbered consecutively and the numbers shall be marked plainly on the packages. There shall be no marking on the containers which might indicate quality or other information. Each bottle shall be identified by means of a tag securely fastened to it.

The judges of market milk shall have prepared regulation size sediment discs representing the bottled milk used in the contest. These discs shall be displayed in a petri dish. They shall be numbered and placed in numerical order accessibly on an adequately lighted table.

The milk samples shall be set out at a temperature of 60° F. at the time of scoring. The official judges shall score each sample of milk for flavor just before submitting it to the students. The container and closure and sediment shall be scored by the official judge on the same table on which they will be scored by the students.

The official judge of ice cream shall set out in an appropriate dish one dipper of ice cream from each sample at the beginning of each judging period and again at 15 minutes thereafter so that the student shall have the opportunity to see various stages of melting. Those dishes shall not be handled by the students or the judges.

Judges

A judging committee for each product shall consist of (1) an official judge from a commercial dairy enterprise to be selected by the superintendent of the contest and (2) two coaches of teams entered in the contest, to be selected by the Committee on the Judging of Dairy Products, American Dairy Science Association. Insofar as possible, the Committee shall select coach judges of experience and

of wide geographical distribution, keeping in mind the best interest of the contest.

All judges of dairy products and coaches assisting the judges shall remain in the contest room until the contestants are under the direct supervision of the superintendent of the contest.

The products shall be judged on the basis described on pages 427 to 430 and shall be checked after actually being placed on the table for the judging contest.

It shall be the duty of the official judge to score each sample of the product which he is judging, write in his scores and **check the criticisms which correctly characterize the product and which shall be considered later in grading contestant criticisms**, on cards that will be identical with those used by the contestants.

The coach judges shall score the samples **working independently of each other and of the official judge.** If the judges' scores on any sample differ by more than one point on flavor or more than one-half point on any other item, or more than one point in total, and they are unable to bring their scores within these limits, a new sample shall be submitted. The criticisms shall agree in all particulars. Each judge shall satisfy himself that a defect called attention to by the other judges is apparent to himself, or such defect shall not be noted. A new sample shall be called for in case of disagreement. A member of the Committee on Judging Dairy Products, American Dairy Science Association, shall be assigned to the official judging for counsel, if necessary.

The coach judges shall check the final official score card noting particularly that all criticisms to be considered in grading contestant criticisms are checked thereon and that the official judging has been done according to the rules.

After the contest is over the coaches may score the various products, and the judges shall then give their scores and explain their criticisms to the coaches.

Grading of Contestants' Cards

The contestants' score cards shall be graded by a committee consisting of the superintendent of the contest, his assistants and the official judges, and at least one representative (preferably the coach) of each college having a team in the contest. The grading shall be done as follows:

Score. A contestant's score on each item on the score card will be given a grade expressed by the difference between his score, except as indicated below, and the official score. For example, if a contestant scores "flavor" 37 and the judges' score is 35, the contestant shall receive a grade of 2 points. The grades shall be recorded with a red pencil.

If, however, a contestant recognizes that the item scores perfect, but fails to indicate that score on his score card, or writes in any score outside the range of score for the item, or indicates the score by a dash (—) he shall receive a grade equivalent to the maximum cut for that item. For example, the normal range of score on body of butter, 23-25, represents a maximum cut of 2 points. The contestant's grade, therefore, shall be 2, when he fails to write in the numerical score for that item. Likewise, the demerit, or grade, for color item in butter would be 2, salt 1, and so on. This rule holds regardless of the official score.

Criticism. The grading of criticisms, which is independent of the grading of scores, is based on the contestant's proficiency in recognizing the same quality merits and defects of the various samples as noted by the official judge. Each criticism indicated by the official and by the contestant shall be involved in the grading. The contestant's grade on criticisms for a single item shall be:

(1) **perfect**, 0, when the contestant
   - (a) checks precisely the same defect(s) as the official and checks **only** those made by the official, or
   - (b) recognizes with the official that the item is above criticism, under which conditions a check is not necessary.

(2) **the maximum**, 1.0 point, when the contestant
   - (a) fails to check any of the defect(s) noted by the official judge,
   - (b) checks a defect(s) when the sample was judged by the official as being above criticism, or
   - (c) fails to check a criticism(s) when the official judge scores the sample within the criticizable range (although the contestant may have scored the sample above criticism).

(3) **less than one**, 0.25, 0.33, 0.50, 0.67 or 0.75 etc. of a point according to the percentage of the criticisms checked correctly. Examples:
   - (a) the official checks 3 criticisms and the contestant checks only one, which is identical with one of the official criticisms. The grade shall be 0.67.
   - (b) The official checks one criticism and the contestant checks three, one of which coincides with that of the official. The grade shall be 0.67.
   - (c) the official checks 3 criticisms and the contestant checks 3, one of which is identical with one of the official criticisms. The grade shall be 0.80. (A total of 5 **different** criticisms has been involved by the official and contestant. The contestant and official agree on one of them. Thus the contestant is 1/5 correct or 4/5 incorrect, meriting a grade of 0.80.)

Grades. A contestant's grade on a sample shall be the sum of his grades on "score" and "criticisms" of that sample. His grade on a product shall be the sum of his grades on the 10 samples of that product.

A team grade for each product shall be the sum of the grades of its members.

As "grade" in this contest means "points lost," the contestant with the lowest "grade" shall be the winner for the product and the team with the lowest "grade" shall be the winning team for the product.

Contestant Standings in Each Product shall be obtained by arranging the grades of all contestants in that product in order from the lowest to the highest. **Team standings in each product** shall be obtained the same way.

Contestant Standings in All Products shall be determined by arranging the sum of the ranks of the individual in each of the four products in order from the lowest to the highest. **Team standings in all products** shall be determined by arranging the sum of the ranks of the team in each of the four products in order from the lowest to the highest.

Breaking Ties. When two or more contestants or teams (except teams in "all products") tie for a place for which a prize is awarded, the ties shall be broken in favor of the contestant or team having the lowest "grade" on flavor; if there is still a tie it shall be broken in favor of the one having the lowest grade on other items in the order in which they appear on the various score cards. If no prize is involved the placing shall remain a tie.

Team ties in "all products," involving a prize, shall be broken in favor of the team having the least sum of the individual grades (points lost) in the judging of the separate products. If no prize is involved the placing shall remain a tie.

BUTTER SCORE CARD

Flavor

Score 45-38 ....No criticism

Score 37.5 or less.	Acidy	Feed	Musty	Storage
	Bitter	Fishy	Neutralizer	Tallowy
	Briny	Flat	Oily	Unclean
	Cheesy	Garlic	Old Cream	Weedy
	Coarse	Malty	Oxidized	Woody
	Cooked	Metallic	Rancid	Yeasty

Body

Score 25 ....No criticism

Score 24.5 or less.	Crumbly	Gummy	Mealy	Sticky
	Greasy	Leaky	Salvy	Weak

Color

Score 15 ....No criticism

Score 14.5 or less ...	Mottles	Uneven
	Specks	Wavy

Salt

Score 10 ....No criticism

Score 9.5 or less ......Gritty

Package

Score 5 ....No criticism

Score 4.5 or less ....Soiled package   Poor finish

As the container may become soiled and the parchment disarranged by the contestants, "Package" will be given a perfect score in this contest.

Contestant will score each item and check criticisms in space provided. Smallest cut on any item ½ point.

Normal range of score is given below, but this should not be interpreted to mean that all samples in this contest will be scored within this range.

Normal range of score on flavor	31-39
Normal range of score on body	23-25
Normal range of score on color	13-15
Normal range of score on salt	9-10
Normal range of score on package	4-5

MILK SCORE CARD

Flavor

Score 45-40 ....No criticism

Score 39.5 or less ..	Barny	Feed	Malty	Rancid
	Bitter	Flat	Metallic	Salty
	Cooked	Garlic or Onion	Musty	Unclean
	Cowy	High Acid	Oxidized	Weedy
	Disinfectant			

Sediment

Score sediment as per U. S. Department of Agriculture Sediment Standards for Milk and Milk Products. This sediment chart was approved by the American Dairy Science Association, June 1949. Only three of the discs on this chart will be used. The disc representing 0.000 mg. of dirt scoring 10, the disc representing 0.025 mg. of dirt scoring 9, and the disc representing 0.050 mg. of dirt scoring 8. Score quarter points between 8 and 9.5 and one-tenth points between 9.5 and 10.

Container and Closure

Score 5 ....No criticism

Score 4.75 or less	Closure leaky	Lip chipped
	Container closure unsealed	Lip unprotected
		Lip partly protected
	Container not full	Lip cover nonwaterproof
	Container dirty	Torn closure cover
	Container dented	
	Container leaky	

The complete score card includes the items "Bacteria (35)" and "Temperature (5)." In this contest both of these items are given a perfect score.

Cuts on Container and Closure

Container closure unsealed	.25
Container not full (milk line below lip roll)	.5
Container dirty on the inside	1.0
Container dented	.25
Container leaky	1.0
Closure poorly seated or leaky (if uncovered)	.5
Lip chipped	.25
Lip unprotected	1.0
Lip partly protected	.5
Lip cover nonwaterproof	.5
Torn closure cover (nonwaterproof)	.5

When paper containers or dummies are used they shall be considered as being full.

Contestant will score each item and check criticisms in space provided.

Normal range of score is given below, but this should not be interpreted to mean that all samples in this contest will be scored within this range.

Normal range of score on flavor	25-40
Normal range of score on sediment	8-10
Normal range of score on container and closure	3-5

ICE CREAM SCORE CARD

Flavor

Score 45-40 .... No criticism

Score 39.5 or less.. Cooked, Egg, High acid, Lacks fine flavor, Lacks flavoring, Lacks freshness, Lacks sweetness, Metallic, Neutralizer, Old ingredient, Oxidized, Rancid, Salty, Storage, Too high flavor, Too sweet, Unclean, Unnatural flavoring, Unnatural sweetener

Body and Texture

Score 30-29.5 .... No criticism

Score 29 or less... Coarse or icy, Crumbly, Fluffy, Gummy, Sandy, Soggy, Weak

Melting Quality

Score 5 .... No criticism

Score 4.5-4........ Curdy, Does not melt

Color and Package

Score 5 .... No criticism

Score 4.5-3 ...... Color uneven, Color unnatural

The complete score card includes the item "Bacteria (15)." In this contest this item will be given a perfect score.

As the container may become soiled and the parchment disarranged by the contestants, "Package" will be given a perfect score in this contest.

Contestant will score each item and check criticisms in space provided. Smallest cut on any item ½ point.

Normal range of score is given below, but this should not be interpreted to mean that all samples in this contest will be scored within this range.

Normal range of score on flavor	31-40
Normal range of score on body and texture ...	25-29.5
Normal range of score on melting quality	4- 5
Normal range of score on color and package ..	3- 5

CHEESE SCORE CARD

Flavor

Score 45-40				No criticism
Score 39.5 or less	Acidy	Fermented	Heated	Unclean
	Bitter	Flat	Moldy	Weedy
	Feed	Fruity	Rancid	Whey taint
				Yeasty

Body and Texture

Score 30-29.5				No criticism
Score 29 or less	Corky	Gassy	Pasty	Sweet curd holes
	Crumbly	Mealy	Short	Weak
	Curdy	Open	Spongy	Yeast holes

Finish

Score 15			No criticism
Score 14.5 or less	Cracked rind	Moldy	Soiled
	Huffed	Rot spots	Uneven surfaces
	Light spots	Scaly paraffin	Wrinkled bandage

Color

Score 10				No criticism
Score 9.5 or less	Acid cut	Mottled	Seamy	Wavy

As the finish may become soiled and the surface damaged by sampling, "Finish" will be given a perfect score in this contest unless separate cheeses are furnished to be scored for this item only.

Contestants will score each item and check criticisms in space provided. Smallest cut on any item ½ point.

Normal range of score is given below, but this should not be interpreted to mean that all samples in this contest will be scored within this range.

Normal range of score on flavor	35-42
Normal range of score on body	26-29.5
Normal range of score on finish	14-15
Normal range of score on color	9-10

E. O. Anderson
C. J. Babcock
P. A. Downs
F. H. Herzer
G. M. Trout, Chairman

Committee on Judging Dairy Products, American Dairy Science Association.

BUTTER SCORE CARD

Contestant No. ______________

Place scores opposite the rating for perfect score. Check criticism * in space opposite the defects noted and in proper sample column. Write in other criticisms if necessary. Do NOT write in space indicating grade. Total the score of each sample. Use black pencil.

Perfect score	Criticisms		Sample No.										Summary of contestant grades
			1	2	3	4	5	6	7	8	9	10	
FLAVOR 45	Contestant score												
	Grade on	score											
		criticism											
	Acidy												
	Bitter												
	Briny												
	Cheesy												
	Coarse												
	Cooked												
	Feed												
	Fishy												
	Flat												
	Garlic												
	Malty												
	Metallic												
	Musty												
	Neutralizer												
	Oily, oxidized, tallowy												
	Old cream												
	Rancid												
	Storage												
	Unclean												
	Weedy												
	Woody												
	Yeasty												
BODY AND TEXTURE 25	Contestant score												
	Grade on	score											
		criticism											
	Crumbly												
	Greasy												
	Gummy												
	Leaky												
	Mealy												
	Salvy												
	Sticky												
	Weak												
COLOR 15	Contestant score												
	Grade on	score											
		criticism											
	Mottles, uneven, wavy												
	Specks												
SALT 10	Contestant score												
	Grade on	score											
		criticism											
	Gritty												
PACKAGE 5	Allowed perfect in contest		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
TOTAL 100	T[illegible]												
	Total grade per sample												

FINAL GRADE ______

RANK ______

*FLAVOR No criticism 38 to 45; normal range 31 to 39.
BODY AND TEXTURE: No criticism 25, normal range 23 to 25
COLOR. No criticism 15, normal range 13 to 15
SALT No criticism 10, normal range 9 to 10
PACKAGE (Allowed perfect in contest)

Fig. 102—Butter Score Card Used in the Collegiate Students' International Contest in the Judging of Dairy Products.

MILK SCORE CARD Contestant No. ____________

Place scores opposite the rating for perfect score. Check criticism * in space opposite the defect noted and in proper sample column. Write in other criticisms if necessary. Do NOT write in space indicating grade. Total the score of each sample. Use black pencil.

Perfect score	Criticisms	Sample No. 1	2	3	4	5	6	7	8	9	10	Summary of contestant grades
FLAVOR 45	Contestant score											
	Grade on score											
	Grade on criticism											
	Barny, unclean											
	Bitter, rancid											
	Cooked											
	Cowy											
	Disinfectant											
	Feed											
	Flat											
	Garlic or onion											
	High acid											
	Malty											
	Metallic											
	Musty											
	Oxidized											
	Salty											
	Weedy											
SEDIMENT 10	Contestant score											
	Grade on score											
CONTAINER AND CLOSURE 5	Contestant score											
	Grade on score											
	Grade on criticism											
	Chipped lip											
	Closure leaky											
	Dirty											
	Lip partly protected											
	Lip unprotected											
	Non-waterproof cover											
	Not full											
	Torn closure cover											
	Unsealed											
BACTERIA 35	Allowed perfect in contest	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
TEMPERATURE 5	Allowed perfect in contest	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
TOTAL 100	Total score of each sample											
	Total grade per sample											

FINAL GRADE	
RANK	

* **FLAVOR** No criticism: 40 to 45; normal range: 25 to 40
SEDIMENT (Not criticized); normal range 8 to 10
CONTAINER AND CLOSURE No criticism: 5; normal range 3 to 5
BACTERIA (Allowed perfect in contest)
TEMPERATURE (Allowed perfect in contest)

INDIVIDUAL RANK-ALL PRODUCTS

PRODUCT	GRADE	RANK
MILK		
BUTTER		
CHEESE		
ICE CREAM		
TOTAL		
RANK		

Fig. 103—Milk Score Card Used in the Collegiate Students' International Contest in the Judging of Dairy Products.

ICE CREAM SCORE CARD Contestant No. ____________

Place scores opposite the rating for perfect score. Check criticism * in space opposite the defect noted and in proper sample column. Write in other criticisms if necessary. Do NOT write in space indicating grade. Total the score of each sample. Use black pencil.

Perfect score	Criticisms	Sample No. 1	2	3	4	5	6	7	8	9	10	Summary of contestant grades
FLAVOR 45	Contestant score ➧											
	Grade on score											
	Grade on criticism											
	Cooked											
	Egg											
	High acid											
	Lacks fine flavor											
	Lacks flavoring											
	Lacks freshness											
	Lacks sweetness											
	Neutralizer											
	Old ingredient											
	Oxidized, metallic											
	Rancid											
	Salty											
	Storage											
	Too high flavor											
	Too sweet											
	Unclean											
	Unnatural flavoring											
	Unnatural sweetener											
BODY AND TEXTURE 30	Contestant score ➧											
	Grade on score											
	Grade on criticism											
	Coarse, icy, weak											
	Crumbly											
	Fluffy											
	Sandy											
	Soggy, gummy											
MELTING QUALITY 5	Contestant score ➧											
	Grade on score											
	Grade on criticism											
	Curdy											
	Does not melt											
COLOR AND PACKAGE 5	Contestant score ➧											
	Grade on score											
	Grade on criticism											
	Color uneven											
	Color unnatural											
BACTERIA 15	Allowed perfect in contest	15	15	15	15	15	15	15	15	15	15	
TOTAL 100	Total score of each sample ➧											
	Total grade per sample											
											FINAL GRADE	
											RANK	

FLAVOR No criticism: 40 to 45, normal range: 31 to 40
BODY AND TEXTURE No criticism: 29.5 to 30, normal range. 25 to 29.5
MELTING QUALITY No criticism 5, normal range. 4 to 5
COLOR AND PACKAGE No criticism 5, normal range. 3 to 5
BACTERIA (Allowed perfect in contest)

Fig. 104—Ice Cream Score Card Used in the Collegiate Students' International Contest in the Judging of Dairy Products.

CHEESE SCORE CARD — Contestant No. ____________

Place scores opposite the rating for perfect score. Check criticism * in space opposite the defect noted and in proper sample column. Write in other criticisms if necessary. Do NOT write in space indicating grade. Total the score of each sample. Use black pencil.

Perfect score	Criticisms		Sample No. 1	2	3	4	5	6	7	8	9	10	Summary of contestant grades
FLAVOR 45	Contestant score												
	Grade on	score											
		criticism											
	[illegible]												
	Bitter												
	[illegible]												
	[illegible]												
	Fruity, yeasty												
	Heated												
	Musty												
	Rancid												
	Unclean												
	Weedy												
	Whey taint												
BODY AND TEXTURE 30	Contestant score												
	Grade on	score											
		criticism											
	[illegible]												
	[illegible]												
	[illegible]												
	[illegible]												
	[illegible]												
	[illegible]												
	[illegible]												
	[illegible]												
	Spongy												
	Sweet curd holes												
	Weak												
	Yeast holes												
FINISH 15	Allowed perfect in contest		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
COLOR 10	Contestant score												
	Grade on	score											
		criticism											
	[illegible]												
	[illegible]												
	[illegible]												
	Wavy												
TOTAL 100	[illegible]												
	Total grade per sample												

*FINAL GRADE ____________

RANK ____________

* FLAVOR No criticism: 40 to 45, normal range 35 to 42
BODY AND TEXTURE No criticism: 29.5 to 30, normal range: 26 to 29.5
FINISH (Allowed perfect in contest)
COLOR No criticism: 10, normal range, 9 to 10

Fig. 105—Cheese Score Card Used in the Collegiate Students' International Contest in the Judging of Dairy Products.

Location of the Collegiate Students' International Dairy Products Judging Contest, 1916-1950

Number of Contest	Year	Organization With Whom Affiliated	Location	No. of Teams
1	1916	National Dairy Association	Springfield, Mass.	9
2	1917	" " "	Columbus, Ohio	3
3	1919	" " "	Chicago, Ill.	7
4	1920	" " "	Chicago, Ill.	5
5	1921	" " "	St. Paul, Minn.	8
6	1922	" " "	St. Paul, Minn.	9
7	1923	" " "	Syracuse, N. Y.	7
8	1924	" " "	Milwaukee, Wis.	10
9	1925	" " "	Indianapolis, Ind.	10
10	1926	" " "	Detroit, Mich.	13
11	1927	" " "	Memphis, Tenn	14
12	1928	" " "	Memphis, Tenn.	14
13	1929	" " "	St. Louis, Mo.	15
14	1930	Dairy Industries Supply Assoc.	Cleveland, Ohio	17
15	1931	" " " "	Atlantic City, N. J.	16
16	1932	" " " "	Detroit, Mich.	18
17	1933	" " " "	Chicago, Ill.	17
18	1934	" " " "	Cleveland, Ohio	19
19	1935	" " " "	St. Louis, Mo.	17
20	1936	" " " "	Atlantic City, N. J.	18
21	1937	" " " "	New Orleans, La.	17
22	1938	" " " "	Cleveland, Ohio	23
23	1939	" " " "	San Francisco, Cal.	14
24	1940	" " " "	Atlantic City, N. J.	21
25	1941	" " " "	Toronto, Can.	22
	1942-1946	No contest		
26	1947	Dairy Industries Supply Assoc.	Miami Beach, Fla.	19
27	1948	" " " "	Atlantic City, N. J.	26
28	1949	" " " "	Los Angeles, Cal.	18
29	1950	" " " "	Atlantic City, N. J.	26

Summary of Colleges Leading in the Judging of Dairy Products

Year	Colleges Winning First Place in Dairy Products Judging, by Years					No. Teams Per Year
	Butter	Cheese	Milk	Ice Cream	All Products	
1916..	Penn.*	....	....	....	....	9
1917..	S. Dakota	Nebraska	S. Dakota	**	***	3
1918..	****	....	....	......	....	..
1919..	Iowa	Ohio	S. Dakota	....	S. Dakota	7
1920..	S. Dakota	Ohio	Ohio	....	Ohio	5
1921..	Ohio	Ohio	Ohio	....	Ohio	8
1922..	S. Dakota	Ohio	Mass.	....	Ohio	9
1923..	Penn.	Ohio	Ohio	....	Pennsylvania	7
1924..	Iowa	Purdue	Mass.	....	Iowa	10
1925..	S. Dakota	Iowa	W. Va.	....	Iowa	10
1926..	Oregon	S. Dakota	Iowa	Iowa	Iowa	13
1927..	Iowa	Tennessee	Kansas	Mass.	Iowa	14
1928..	Iowa	W. Va.	S. Dakota	Ohio	Iowa	15
1929..	Oregon	Ohio	Ohio	Iowa	Ohio	15
1930..	Mississippi	Kansas	W. Va.	Illinois	Kansas	17
1931..	Mississippi	Michigan	Iowa	Vermont	Iowa	16
1932..	Purdue	Michigan	Purdue	Mississippi	Mississippi	18
1933..	S. Dakota	Wisconsin	Illinois	Mass.	Ohio	17
1934..	Minnesota	Iowa	Mississippi	Ohio	Ohio	19
1935..	Tennessee	Mississippi	Tennessee	Nebraska	Mississippi	17
1936..	Iowa	Tennessee	Ohio	Cornell	Ohio	18
1937..	Nebraska	Minnesota	S. Dakota	Ohio	Ohio	17
1938..	Iowa	Cornell	Ohio	Cornell	Cornell	23
1939..	Iowa	Wisconsin	Iowa	Iowa	Iowa	14
1940..	Minnesota	Mississippi	Iowa	Conn.	Iowa	21
1941..	Conn.	Michigan	Ohio	Conn.	Ohio	22
1942-1946	****	....	....	....	.. ..	..
1947..	Conn.	Mississippi	Conn.	Iowa	Connecticut	19
1948..	Iowa	Michigan	Iowa	Tennessee	Iowa	26
1949..	Minnesota	Mississippi	Kansas	Iowa	Mississippi	18
1950	Iowa	Iowa	Conn.	Mississippi	Iowa	26

*Butter only judged in 1916.
**Ice Cream not included until 1926.
***No rating for all products.
****No contest because of World War.

The Judges Who Placed the Official Scores and Criticisms on the Samples of Butter, Cheese, Milk, and Ice Cream, in the Collegiate Students' International Dairy Products Judging Contest Since 1926

Year	Butter	Cheese	Milk	Ice Cream
1926	L. E. Gaylord	C. W. Freyhoffer	R. J. Posson	H. F. Judkins
	H. W. Gregory	E. L. Aderhold	C. E. Clement	C. S. Trimble
1927	L. S. Edwards	G. N. Tobey	R. J. Posson	H. F. Judkins
	G. A. Gilbert	G. A. Gilbert		
1928	G. A. Gilbert	G. A. Gilbert	C. J. Babcock	W. H. E. Reid
	L. S. Edwards	G. N. Tobey	R. W. Bell	
		L. H. Marlatt		
1929	H. D. Reynolds	H. L. Wilson	C. J. Babcock	W. H. E. Reid
	L. S. Edwards	William White	C. S. Leete	P. H. Tracy
1930	O. A. Storvick	H. L. Wilson	Ernest Kelly	A. C. Dahlberg
	H. D. Reynolds	J. W. Moore	C. J. Babcock	A. D. Burke
1931	L. D. Reekie	H. L. Wilson	C. J. Babcock	A. C Dahlberg
	L. S. Edwards	W. E. Ayers	F. M. Grant	A D. Burke
1932	C. E. Eckles	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1933	C. L. Pier	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1934	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1935	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1936	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1937	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1938	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1939	B. J. Ommodt	F. H. McCampbell	A. W. Hayes	F. W. Milner
1940	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
1941	L. S. Edwards	H. L. Wilson	C. J. Babcock	A. C. Dahlberg
		D. M. Beattie		
1942 } 1946 }	No Contests	....	....	....
1947	N. E. Fabricius	H. L. Wilson	R. Whitaker	J. H. Erb
1948	N. E. Fabricius	H. L. Wilson	R. Whitaker	J. H. Erb
1949	N. E. Fabricius	H. L. Wilson	R. Whitaker	J. H. Erb
1950	N. E. Fabricius	H. L. Wilson	R. Whitaker	J. H. Erb

IDENTIFICATION OF DAIRY PRODUCTS JUDGES

Ice Cream

A. D. Burke, Alabama Polytechnic Institute, Auburn, Ala.
A. C. Dahlberg, N. Y. Agr. Expt. Sta., Geneva, N. Y.
H. F. Judkins, Eastern States Dairies, Springfield, Mass.
W. H. E. Reid, University of Missouri, Columbia, Mo.
P. H. Tracy, University of Illinois, Urbana, Ill.
C. S. Trimble, Bureau of Dairy Industry, Washington, D. C.
F. W. Milner, California State Dept. of Agr., Sacramento, Calif.
J. H. Erb, The Borden Co., Columbus, Ohio

Butter

L. S. Edwards, Bureau of Dairy Industry, Nashville, Tenn.
L. E. Gaylord, Bureau of Agricultural Economics, Washington, D. C.
G. A. Gilbert, U. S. Food Products Inspector, Chicago, Ill.
H. W. Gregory, Purdue University, Lafayette, Ind.
H. D. Reynolds, Butter Grader, Mason City, Iowa.
O. A. Storvick, Butter Grader, Albert Lea, Minn.
L. D. Reekie, Bureau of Agricultural Economics, New York City.
C. E. Eckles, Bureau of Agricultural Economics, Washington, D. C.
C. L. Pier, Bureau of Agricultural Economics, Chicago, Ill.
B. J. Ommodt, War Food Adm., U. S. Dept. Agr., Washington, D. C.
N. E. Fabricius, Ladysmith Co-operative Milk Association, Ladysmith, Wis.

Cheese

E. L. Aderhold, Neenah, Wis.
W. E. Ayers, Cornell University, Ithaca, N. Y.
C. W. Fryhofer, Bureau of Agr. Economics, Washington, D. C.
G. A. Gilbert, U. S. Food Products Inspector, Chicago, Ill.
L. H. Marlatt, Cheese Specialist, Athens, Ga.
J. W. Moore, Dept. of Agr. and Markets, Madison, Wis.
G. N. Tobey, Cheese Specialist, Knoxville, Tenn.
Wm. White, Bureau of Dairy Industry, Washington, D. C.
H. L. Wilson, Kraft Foods Co., Chicago, Ill.
F. H. McCampbell, Bureau of Agr. Econ., U. S. Dept. Agr., San Francisco, Calif.
D. M. Beattie, Dairy Products Grading and Inspection Service, Ottawa, Canada.

Milk

C. J. Babcock, Bureau of Dairy Industry, Washington, D. C.
R. J. Bell, U. S. Dept. of Agr., Washington, D. C.
C. E. Clement, Bureau of Dairy Industry, Washington, D. C.
Ernest Kelly, Bureau of Dairy Industry, Washington, D. C.
C. S. Leete, Bureau of Dairy Industry, Washington, D. C.
R. J. Posson, Bureau of Dairy Industry, Washington, D. C.
F. M. Grant, Bureau of Dairy Industry, Washington, D. C.
A. W. Hayes, California State Dept. of Agr., Sacramento, Calif.
R. Whitaker, National Dairy Research Lab., Oakdale, Long Island, N.Y.

COLLEGIATE STUDENTS' INTERNATIONAL CONTEST IN JUDGING DAIRY PRODUCTS. FIRST SIX LEADING TEAMS AND INDIVIDUALS, 1930-1950 INCLUSIVE

BUTTER

	Rank					
Year	1st	2nd	3rd	4th	5th	6th
			TEAM			
1930	Mississippi	Kansas	Ontario	Mass.	Michigan	Indiana
1931	Mississippi	Michigan	Mass.	Iowa	Ohio	Nebraska
1932	Indiana	Kansas	Mississippi	Nebraska	Iowa	Illinois
1933	S. Dakota	Ohio	Mississippi	Iowa	Minnesota	Michigan
1934	Minnesota	Ohio	Indiana	New York	Mississippi	S. Dakota
1935	Tennessee	Michigan	Indiana	Iowa	S. Dakota	Ohio
1936	Iowa	Minnesota	Michigan	Conn.	Wisconsin	Ohio
1937	Nebraska	Miss.	Minnesota	Iowa	Michigan	Ohio
1938	Iowa	New York	Maryland	Conn.	Ontario	Michigan
1939	Iowa	Nebraska	Mississippi	Wisconsin	S. Dakota	Penn.
1940	Minnesota	Illinois	Vermont	Iowa	Michigan	N. Hamp.
1941	Connecticut	Illinois	Nebraska	Minnesota	New York	Penn.
1942-1946*	....	....	....	....	....	....
1947	Connecticut	Michigan	New York	Mississippi	Ohio**	Tenn.**
1948	Iowa	Ohio	Mississippi	Michigan	Tennessee	Conn.
1949	Minnesota	Mass.	Michigan	Conn.	Wash.	Miss.
1950	Iowa	Mississippi	Indiana	Minnesota	Tennessee	Ohio
			INDIVIDUAL			
1930	Mississippi	Ohio	Ontario	Michigan	Nebraska	Indiana
1931	Iowa	Illinois	Mississippi	Kansas	Mass.	Ohio
1932	Indiana	Michigan	Mississippi	Kansas	Iowa	Mass.
1933	S. Dakota	Iowa	Ohio	Mississippi	S. Dakota	Nebraska
1934	S. Dakota	Minnesota	Ohio	Indiana	Conn.	New York
1935	Tennessee	Ohio	New York	Michigan	Iowa	Minnesota
1936	Iowa	Maryland	Illinois	Tennessee	Wisconsin	Ohio
1937	Kansas	Nebraska	Nebraska	Mass.	New York	Mississippi
1938	Iowa	Maryland	New York	Maryland	Minnesota	W. Va.
1939	Iowa	Penn.	Iowa	Iowa	Mississippi	Nebraska
1940	Minnesota	Illinois	Iowa	Wisconsin	Mass.	Illinois
1941	Connecticut	Nebraska	Iowa	Illinois	Wisconsin	Vermont
1942-1946*	....	....	....	....	....	....
1947	Connecticut	New York	Conn.	Michigan	Miss.**	Tenn.**
1948	Iowa	Michigan	Conn.	Mississippi	Tennessee	Iowa
1949	Minnesota	Minnesota	Iowa	Illinois	Mass.	Conn.
1950	Tennessee	Mississippi	Iowa	Michigan	Minn.**	W. Va.**

*No contests because of World War II. **Tie

MILK

TEAM

Rank / Year	1st	2nd	3rd	4th	5th	6th
1930	W. Va.	Nebraska	Conn.	Indiana	Ontario	Kansas
1931	Iowa	Mass.	Conn.	Minnesota	Vermont	Penn.
1932	Indiana	Louisiana	Nebraska	Kansas	Indiana	Conn.
1933	Illinois	Kansas	Ohio	Minnesota	Indiana	Iowa
1934	Mississippi	Conn.	Ohio	Michigan	Mass.	Arkansas
1935	Tennessee	Ohio	New York	Mississippi	Minnesota	Indiana
1936	Ohio	Penn.	Conn.	New York	Nebraska	Michigan
1937	S. Dakota	Mississippi	Tex. Tech.	Mass.	Wisconsin	Ohio
1938	Ohio	Michigan	Vermont	New Mex.	Iowa	Conn.
1939	Iowa	Ohio	Mississippi	Wisconsin	Tennessee	Penn.
1940	Iowa	Conn.	Mississippi	New York	Ohio	Minnesota
1941	Ohio	Vermont	Tex. Tech.	Michigan	Penn.	Mass.
1942-1946*	....	....	....	....	....	....
1947	Connecticut	Michigan	Maryland	Mississippi	Tennessee	Tex. Tech.
1948	Iowa	Ohio	Penn.	Maryland	Mass.	Mississippi
1949	Kansas	Iowa	Mississippi	Wash.	Tex. A.&M.	Utah
1950	Connecticut	Michigan	Iowa	Georgia	Ohio	Mississippi

INDIVIDUAL

Rank / Year	1st	2nd	3rd	4th	5th	6th
1930	W. Va.	Nebraska	California	Ohio	W. Va.	Conn.
1931	Vermont	Penn.	Illinois	Mass.	Minnesota	Mississippi
1932	Indiana	Louisiana	Nebraska	Iowa	Kansas	Mass.
1933	Illinois	Minnesota	Illinois	Illinois	Kansas	Ohio
1934	Arkansas	Michigan	Conn.	Mississippi	Oklahoma	Nebraska
1935	Ohio	Mass.	Indiana	Tennessee	Michigan	New York
1936	Ohio	New York	Ohio	Wisconsin	Michigan	Conn.
1937	S. Dakota	Mass.	Wisconsin	Iowa	Mississippi	Tex. Tech.
1938	Illinois	Mass.	Ohio	Ohio	New Mex.	Michigan
1939	Iowa	Ohio	Miss.	Ohio	Wisconsin	Iowa
1940	Iowa	Iowa	Minnesota	Conn.	Ohio	Mass.
1941	Ohio	Penn.	Ohio	Vermont	Mass.	Tennessee
1942-1946*	....	....	....	....	....	....
1947	Michigan	Mass.	Tennessee	Wisconsin	Maryland	Conn.
1948	Penn.	Iowa	Oklahoma	Mississippi	Conn.**	Mich.**
1949	Kansas	Ohio	Iowa	Minnesota	Mississippi	Utah
1950	Connecticut	Michigan	Iowa	Minnesota	Mississippi	Ohio

ICE CREAM

TEAM

Rank / Year	1st	2nd	3rd	4th	5th	6th
1930	Illinois	Wisconsin	Iowa	Nebraska	Oregon	Mississippi
1931	Vermont	W. Va.	Ohio	Michigan	Mass.	Kansas
1932	Mississippi	New York	Kansas	Ohio	Mass.	Maryland
1933	Mass.	Michigan	Arkansas	Minnesota	Kansas	Illinois
1934	Ohio	Tennessee	Illinois	Minnesota	Indiana	Kansas
1935	Nebraska	New York	Mississippi	Minnesota	Conn.	Tennessee
1936	New York	Conn.	Indiana	Minnesota	Ohio	Kansas
1937	Ohio	New York	Michigan	Mass.	Louisiana	S. Dakota
1938	New York	Mass.	Kansas	Iowa	Tennessee	Mississippi
1939	Iowa	Mississippi	Wisconsin	Penn.	Tennessee	S. Dakota
1940	Connecticut	Iowa	Minnesota	Ohio	Wisconsin	Mass.
1941	Connecticut	Mass.	Ohio	New York	Michigan	Maryland
1942-1946*	....	....	....	....	....	....
1947	Iowa	Conn.	Ohio	Tennessee	Tex. Tech.	Illinois
1948	Tenn.	Iowa	Ohio	Minnesota	Penn.	Michigan
1949	Iowa	Conn.	Mississippi	Wash.	Mass.	Idaho
1950	Mississippi	Conn.	Texas A &	Tennessee	New York	Georgia

INDIVIDUAL

Rank / Year	1st	2nd	3rd	4th	5th	6th
1930	Ontario	Iowa	Wisconsin	Illinois	Mississippi	Wisconsin
1931	Michigan	Vermont	Iowa	Kansas	Virginia	Mass.
1932	New York	Mississippi	Mississippi	Mass.	New York	Nebraska
1933	Michigan	Arkansas	Minnesota	Kansas	Illinois	Mississippi
1934	Illinois	Minnesota	Ohio	Indiana	Tennessee	Ohio
1935	New York	Conn.	Nebraska	Wisconsin	Nebraska	Minnesota
1936	New York	Wisconsin	Ontario	Conn.	Ohio	Kansas
1937	Ohio	Ohio	Ohio	New York	S. Dakota	Michigan
1938	Mississippi	New Mex.	Mass.	Tennessee	New York	Iowa
1939	Iowa	Iowa	Mississippi	Minnesota	Tennessee	Iowa
1940	Minnesota	Conn.	Iowa	[illegible]	Conn.	Mississippi
1941	Connecticut	Michigan	New York	Ohio	Mass.	S. Dakota
1942-1946*	....	....	....	....	....	....
1947	Iowa	Maryland	Iowa	Conn.	Tennessee	Ohio
1948	Iowa	N. Car.	Michigan	Ohio	Michigan	Tenn.
1949	Connecticut	Iowa	Kansas	Illinois	[illegible]	Iowa & [illegible]
[illegible]	Mississippi	Mississippi	Tex. A.&M.	N. Car.	Conn.	Conn.

*No contests because of World War II. **Tie

Rank / Year	1st	2nd	3rd	4th	5th	6th
			TEAM			
1930	Kansas	Ohio	Mississippi	Mass.	Wisconsin	Ontario
1931	Michigan	Iowa	Ohio	Nebraska	Kansas	Mass.
1932	Michigan	Ohio	Conn.	Mississippi	Iowa	Kansas
1933	Wisconsin	Mississippi	Michigan	Ohio	S. Dakota	Oklahoma
1934	Iowa	Arkansas	Kansas	Illinois	Tennessee	Michigan
1935	Mississippi	Arkansas	Iowa	New York	Oklahoma	Ohio
1936	Tennessee	Conn.	New York	Ohio	Nebraska	Illinois
1937	Minnesota	Mississippi	Mass.	Iowa	New York	Tennessee
1938	New York	Mississippi	Tex. Tech.	Iowa	Conn.	Ohio
1939	Wisconsin	Iowa	Tennessee	Penn.	Mississippi	Tex. Tech.
1940	Mississippi	Tennessee	Wisconsin	Mass.	New York	Penn.
1941	Michigan	Ohio	Mississippi	Conn.	Iowa	Wisconsin
1942-1946*	....	....	....	....	....	..
1947	Mississippi	Maryland	Tennessee	Tex. Tech.	Michigan	New York
1948	Michigan	Iowa	New York	Ohio	Tex. Tech.	Mississippi
1949	Mississippi	Utah	Michigan	Iowa	Nebraska	Conn.
1950	Iowa	Michigan	Indiana	Conn.	Mississippi	Ohio
			INDIVIDUAL			
1930	Kansas	Illinois	Ohio	Kansas	Mass.	Ontario
1931	Michigan	Iowa	Illinois	Ohio	Kansas	Ohio
1932	Nebraska	Michigan	Iowa	Mississippi	Michigan	Conn.
1933	Nebraska	Wisconsin	Wisconsin	Kansas	Michigan	Mississippi
1934	Arkansas	Iowa	Kansas	Illinois	Minnesota	Nebraska
1935	Ohio	Mississippi	New York	Oklahoma	Arkansas	Iowa
1936	Tennessee	Wisconsin	Illinois	Kansas	New York	New York
1937	Wisconsin	Minnesota	Mass.	Mississippi	Mich.**	Minn.**
1938	Mississippi	Tex. Tech.	New York	Iowa	Ohio	Iowa
1939	Tennessee	Wisconsin	Penn.	Nebraska	Iowa	Penn.
1940	Mississippi	Mississippi	Tennessee	Wisconsin	Vermont	Mass.
1941	Michigan	Iowa	Ohio	Iowa	Michigan	Vermont
1942-1946*	....	....	....	....	....	....
1947	Mississippi	Mississippi	Tex. Tech.	Iowa	Nebraska	Maryland
1948	Penn.	Ohio	Iowa	Michigan	Michigan	New York
1949	Mississippi	Mississippi	Utah	Connecticu	Mississippi	Utah
1950	Mississippi	Iowa	Michigan	Iowa	Michigan	Ohio

ALL PRODUCTS

Rank / Year	1st	2nd	3rd	4th	5th	6th
			TEAM			
1930	Kansas	Mississippi	Nebraska	Ontario	Michigan	Oregon
1931	Iowa	Ohio	Michigan	Mass.	Nebraska	Vermont
1932	Mississippi	Kansas	Indiana	Nebraska	Ohio	Mass.
1933	Ohio	Kansas	S. Dakota	Michigan	Minnesota	Mississippi
1934	Ohio	Minnesota	Kansas	Michigan	Iowa	Arkansas
1935	Mississippi	New York	Tennessee	Ohio	Iowa	Minnesota
1936	Ohio	Conn.	New York	Nebraska	Minnesota	Tennessee
1937	Ohio	Mississippi	Mass.	Michigan	Minnesota	New York
1938	New York	Iowa	Conn.	Mississippi	Michigan	Tennessee
1939	Iowa	Wisconsin	Mississippi	Penn.	Tennesese	Ohio
1940	Iowa	Conn.	Minnesota	Mississippi	Michigan	Mass.
1941	Ohio	Conn.	Michigan	Mass.	Illinois	Vermont
1942-1946*	....	....	....	....	....	
1947	Connecticut	Mississippi	Tennessee	Maryland	Tex.Tech**	Mich.**
1948	Iowa	Ohio	Michigan	Miss.	Tenn.	Conn
1949	Mississippi	Connecticu	Iowa	Kansas	Minnesota	Mass.
1950	Iowa	Mississippi	Conn.	Michigan	Ohio	Georgia
			INDIVIDUAL			
1930	Illinois	Ontario	Mississippi	Kansas	Mississippi	Michigan
1931	Iowa	Mass.	Ohio	Michigan	Mississippi	W. Va.
1932	Mississippi	Nebraska	Indiana	Kansas	Conn.	Mississippi
1933	Illinois	Kansas	Kansas	Mississippi	Minnesota	S. Dakota
1934	Arkansas	Nebraska	Iowa	Minnesota	Ohio	Illinois
1935	New York	Mississippi	Tennessee	Minnesota	Tennessee	Wisconsin
1936	Ohio	New York	Conn.	Wisconsin	Conn.	Illinois
1937	Ohio	S. Dakota	Minnesota	Mississippi	Mass.	Illinois
1938	Mississippi	Iowa	New York	Iowa	New York	Tennessee
1939	Iowa	Iowa	Iowa	Mississippi	Wisconsin	Tennessee
1940	Minnesota	Mississippi	Minnesota	Iowa	Kansas	Iowa
1941	Ohio	Vermont	Michigan	Ohio	Mass.	S. Dakota
1942-1946*	....	....	....	..		
1947	Iowa	Conn.	Mississippi	Michigan	Md.**	Tex.Tech**
1948	Michigan	Iowa	Ohio	Conn.	Ohio	Ohio
1949	Iowa	Mississippi	Minnesota	Illinois	Conn.	Ohio
[illegible]	[illegible]	Mississippi	Conn.	Iowa	Ohio	Iowa

contests because of World War II. **Tie

Schools Participating in the Collegiate Students' International Dairy Products Judging Contest, by Years, 1916-1950

No.	School	Year in which team was entered in contest with team winning first in judging all products designated																													No. of contests in which teams participated
		'16	'17	'19	'20	'21	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34	'35	'36	'37	'38	'39	'40	'41	'47	'48	'49	'50	
1	Arkansas.......					*												*	*	*											4
2	California......								*		*				*									*					*		5
3	Colorado.......																										*	*			2
4	Connecticut....	*						*			*	*			*	*	*	*	*	*	*	*	*		*	*	1	*	*	*	19
5	Florida.........																										*				1
6	Georgia........												*	*					*									*		*	5
7	Idaho..........																												*		1
8	Illinois.........														*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	15
9	Indiana (Purdue)			*	*		*		*	*			*	*	*		*	*	*	*	*	*	*		*	*	*	*		*	20
10	Iowa..........			*	*	*	*		1	1	1	1	1	*	*	1	*	*	*	*	*	*	*	1	1	*	*	1	*	1	26
11	Kansas.........										*	*	*	*	1	*	*	*	*	*	*	*	*	*	*	*		*	*	*	19
12	Kentucky.......																													*	1
13	Louisiana																*					*									2
14	Maryland			*	*			*									*				*		*		*	*	*	*		*	11
15	Massachusetts ..	*					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	24
16	Michigan.......									*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	20
17	Minnesota......					*	*									*	*	*	*	*	*	*	*	*	*	*		*	*	*	16
18	Mississippi											*	*	*	*	*	1	*	*	1	*	*	*	*	*	*	*	*	1	*	19

19	Nebraska.......	*	*	*		*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	27
20	New Hampshire	*						*				*													*			*		*	6
21	New Jersey.....															*					*				*						3
22	New Mexico....																						*	*					*		3
23	NewYork(Cornell)	*		*				*									*	*	*	*	*	*	1		*	*	*	*		*	15
24	North Carolina .										*	*	*															*		*	5
25	Ohio	*	*	*	1	1	1	*	*	*	*	*		1	*	*	*	1	1	*	1	1	*	*	*	1	*	*	*	*	28
26	Oklahoma.....												*	*				*	*	*			*					*	*	*	9
27	Ontario (Canada)														*	*					*		*			*					5
28	Oregon.........						*		*	*	*	*	*	*	*																8
29	Pennsylvania...	*				*		1	*	*	*	*			*	*			*		*		*	*	*	*	*	*		*	18
30	South Dakota...	*	*	1	*	*	*			*	*	*	*	*			*	*	*	*		*	*	*		*	*				20
31	Tennessee......											*	*	*	*				*	*	*	*	*	*	*	*	*	*		*	15
32	Texas (A & M)..																							*		*	*	*	*	*	6
33	Texas (Tech.)...																					*	*	*	*	*	*	*	*	*	9
34	Utah...........																												*		1
35	Vermont.......	*														*	*						*		*	*		*		*	8
36	Virginia........													*		*									*	*		*		*	6
37	Washington.....																												*		1
38	West Virginia...					*	*		*	*	*	*	*	*	*	*	*	*					*					*		*	15
39	Wisconsin......								*						*		*	*	*	*	*	*	*	*	*	*	*	*		*	15
	Total	9	3	7	5	8	9	7	10	10	13	15	14	15	17	16	18	17	19	17	18	17	23	14	21	22	19	26	18	26	

Note: A contest was not held in 1918 due to World War I and from 1942 to 1946 inclusive due to World War II. There was no rating for all products in 1916 and in 1917.

WINNERS OF THE DAIRY INDUSTRIES SUPPLY ASSOCIATION FELLOWSHIPS BY SCHOOLS

1930-1950, Inclusive

Winners of DISA Fellowship		Training as a Graduate Student	
Name	Year Fellowship Was Awarded	DISA Fellow	Year Fellowship Was Awarded
University of ARKANSAS (1)*			
Niven, Charles F.	1934		
University of CALIFORNIA (0)			
		Homberger, R. E.	1931
University of CONNECTICUT (8)			
Gibson, G. L.	1932	Freeman, Robert	1935
Kosikowsky, Frank V.	1938		
Marland, Richard E.	1941		
Tobie, Alan F.	1947		
Hunt, Roger W.	1949		
Parkin, Willis E.	1950		
CORNELL University (4)			
Tomlinson, Albert S.	1936	Cantley, R. W.	1932
Brereton, John G.	1937	Chilson, William H.	1933
Ludington, V. D.	1938	Niven, Charles F.	1934
		Ford, Mark	1935
		Naylor, H. Brooks	1937
		Kosikowsky, Frank V.	1938
		Tobie, Alan F.	1947
University of ILLINOIS (2)			
Ross, O. E.	1930	Haradine, C. E.	1931
Corbett, W. J.	1933	Gibson, G. L.	1932
		Brown, Howard W.	1934
		Smith, Hiram P.	1935
		Wilson, C. Ashley	1938
		Hollender, Herbert A.	1939
		Moore, Donald R.	1948
IOWA State College (8)			
Ause, O. H.	1931	Ross, O. E.	1930
Brown, Howard W.	1934	Shepherd, Sidney	1932
Ford, Mark	1935	Hostetler, P.	1933
Wilson, C. Ashley	1938	Slatter, Walter L.	1934
Russell, Ocrel M.	1939	Warner, James N.	1935
Sandine, William E.	1950	Harris, William C.	1937
		Ludington, V. D.	1938
		Graham, Dee M.	1949
KANSAS State College (5)			
Hostetler, P.	1933	Leach, H. J.	1931
Chilson, William H.	1933		
Byers, E. L.	1934		
MASSACHUSETTS State College (2)			
Shepherd, Sidney	1932	Brockschmidt, J. H.	1931
MacCurdy, Robert D.	1937	Hunt, Roger W.	1949

*Figure in parenthesis indicates the number of Fellowships which were actually won and awarded to individuals or teams of that particular school. For one or more reasons, the Fellowships were sometimes forfeited in which case they were reawarded to the next highest standing team or individual. Thus, the number of fellows from a particular school may be more or less than the number actually won.

MICHIGAN State College (5)

Dowd, L. R.	1930	Goodwillie, D. B.	1930
Haradine, C. E.	1931	Long, John H.	1932
Babel, Fred J.	1934	Larson, Richard A.	1936
Openlander, H. F.	1936	MacCurdy, Robert D.	1937
Moore, Donald R.	1948	Marland, Richard E.	1941
		Shiffermiller, W. E.	1948

University of MINNESOTA (6)

Sorenson, C. M.	1933	Ause, O. H.	1931
Josephson, Donald V.	1934	Carithers, R. L.	1933
Freeman, Robert	1935	Roberts, W. M.	1936
Rivers, Phillip W.	1936	Brereton, John G.	1937
Naylor, H. Brooks	1937		
Mykleby, R. W.	1940		

MISSISSIPPI State College (11)

Quinn, J. D.	1930		
Whitfield, B. H.	1931		
Long, John H.	1932		
Carithers, R. L.	1933		
Harris, William C.	1937		
Graham, Dee M.	1949		
Gilmore, Thomas E.	1950		

University of NEBRASKA (2)

Kelley, Martin F.	1930	Whitfield, B. H.	1931
Meredith, P. W.	1932		
Warner, James N.	1935		
Larson, Richard A.	1936		

University of NORTH CAROLINA (0)

Sandine, William E.	1950		

OHIO State University (7)

Homberger, R. E.	1931	Quinn, J. D.	1930
Brockschmidt, J. H.	1931	Meredith, P. W.	1932
Charles, Donald A.	1932	Spicer, W. Delmar	1933
Slatter, Walter L.	1934	Rippen, A. L.*	1935
Smith, Hiram P.	1935	Openlander, H. F.	1936
Rippen, A. L.**	1935	Henry, David	1937
Adams, Joseph	1936		
Roahen, Dan C.	1937		
Shiffermiller, W. E.	1948		

ONTARIO Agricultural College (1)

Goodwillie, D. B.	1930		

PENNSYLVANIA State College (0)

Bradley, H. A.**	1930	Bradley, H. A.**	1930
Snyder, Walter E.	1940	Josephson, Donald V.	1934
		Rivers, Phillip W.	1936
		Russell, Ocrel M.	1939
		Parkin, Willis E.	1950
		Russell, Ocrel M.	1939
		Mykleby, R. W.	1940

PURDUE University (1)

Cantley, R. W.	1932	Dowd, L. R.	1930
		Sorenson, C. M.	1933
		Babel, Fred J.	1934
		Flake, J. C.	1935
		Adams, Joseph	1936

**Finished work started by Fellowship winner.

SOUTH DAKOTA State College (1)

Spicer, W. Delmar 1933
Henry, David 1937

University of TENNESSEE (2)

Flake, J. C. 1935
Roberts, W. M. 1936

University of VERMONT (0)

Leach, H. J. 1931

University of WEST VIRGINIA (1)

(Forfeited)

University of WISCONSIN (1)

Hollender, Herbert A.	1939	Kelley, Martin F.	1930
		Charles, Donald A.	1932
		Corbett, W. J.	1933
		Byers, E. L.	1934
		Tomlinson, Albert S.	1936
		Roahen, Dan C.	1937
		Snyder, Walter E.	1940
		Gilmore, Thomas E.	1950

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1930

1. Ross, O. E. Why Does a Tallowy Flavor Develop in Strawberry Ice Cream? Ice Cream Trade Journal, July, 1933.
2. Goodwillie, D. B., and Trout, G. M. Factors Other Than Bacteria That Influence the Body and Flavor of Granuled Buttermilk. The Milk Dealer, February and March, 1933.
3. Quinn, J. D., and Burgwald, L. H. High Short Holding and Low Long Holding Pasteurization of Milk. Milk Plant Monthly, February, 1933.
4. Bradley, H. H., and Dahle, C. D. How Freezing and Hardening Affects the Texture of Ice Cream. The Ice Cream Trade Journal, November, 1933.
5. Dowd, L. R. Some Factors Affecting the Efficiency of Pasteurization of Milk. American Creamery and Poultry Produce Review, January, 1935.
6. Kelly, Martin F., and Price, Walter V. A Study of the Manufacture of Cottage Cheese. National Butter and Cheese Journal, February, 1933.

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1. Ause, O. H., and Macy, H. The Relation of Oospora Lactis to the Keeping Quality of Butter. American Creamery and Poultry Produce Review, December, 1934.
2. Homberger, R. E., and Cole, W. C. Factors Affecting Lactose Crystallization as Related to Sandy Ice Cream. The Ice Cream Review, November, 1933.
3. Haradine, C. E. Inversion of Sucrose in the Manufacture of Sweetened Condensed Milk, and Its Effect Upon Color of Finished Product. National Butter and Cheese Journal, October, 1933.

4. Whitfield, Benjamin H., Davis, H. P., and Downs, P. A. The Effect of Milk Upon Metals and Metals Upon Milk. The Milk Dealer, November and December, 1934, and January, 1935.
5. Leach, H. J., and Martin, W. H. The Effect of a Surface Cooler on Flavor, Cream Line and Evaporation Loss. American Creamery and Poultry Produce Review, November, 1933.
6. Brockschmidt, J. H., Mack, M. J., and Frandsen, J. H. How to Make High Butterfat Ice Cream; A Study of the Factors Involved in Making the Richer Type of Product. Ice Cream Field, December, 1933, and January, 1934.

1932

1. Long, John H., Huffman, C. F., and Duncan, C. W. A Study of the Vitamin D Requirements of Calves When Natural Milk Furnished the Sole Source of the Antirachitic Factor. Milk Plant Monthly, July, 1936.
2. Meredith, Perry W., and Stoltz, R. B. Bottled Concentrated Milk, A Lower Priced Fresh Milk for the Consumer. The Milk Dealer, February, 1935.
3. Cantley, Robert W. Comparison of Skimmed Milk Powder Media With Standard Nutrient Agar for Bacterial Counts on Milk. Ice Cream Field, May and June, 1935.
4. Gibson, G. L. Sandiness: Its Causes and Prevention. Ice Cream Field, May and June, 1935.
5. Shepard, Sidney, and Olson, H. C. The Relationship Between Changes in the Number of Bacteria and in the Scores of Butter Held at 32° F. National Butter and Cheese Journal, September, 1935.
6. Charles, D. A., and Sommer, H. H. Causes and Practical Methods for Control of Sedimentation in Homogenized Milk. Milk Plant Monthly, April, 1935.

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1. Corbett, W. J., Frazier, W. J., and Price, W. V. A Gas Defect of Cream Cheese. The Milk Dealer, December, 1935.
2. Hostetler, Pius H. Effects of Preservatives on Results of Fat Test Studies. Confectionery and Ice Cream World, August, 1936.
3. Chilson, William H. A Study of the Oxidized Flavors of Market Milk. Milk Plant Monthly, November and December, 1935.
4. Carithers, Robert L., and Combs, W. B. Drum vs. Spray Process Dry Milk in Ice Cream. The Ice Cream Review, March, 1936.
5. Sorenson, C. M. Studies on Milk Mold Oospora Lactis. American Creamery and Poultry Produce Review, February, 1936.
6. Spicer, W. Delmar, and Burgwald, L. H. Use of Hydrogen Ion Determination on Young Cheese in Predicting Acid Development in Cheddar Cheese During Storage. National Butter and Cheese Journal, November, 1935.

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1. Slatter, Walter L. Changes in the Acetylmethylcarbinol Plus Diacetyl Content of Butter. National Butter and Cheese Journal, October and November, 1936.
2. Dahle, C. D., and Josephson, D. V. The Importance of the Fat Globule Membrane in the Freezing of Ice Cream. The Ice Cream Review, January, 1937.
3. Byers, E. L., and Price, Walter V. Influence of Salt on the Composition and Quality of Brick Cheese. National Butter and Cheese Journal, July, 1937.
4. Babel, F. J. Significance of Laboratory Tests in the Control of Ice Cream. The Ice Cream Trade Journal, September, 1936.

5. Brown, W. H. This Matter of Mix. Ice Cream Field, July and August, 1937.
6. Sherman, J. M., and Niven, Charles F. The Hemolytic Streptococci of Milk. Journal of Infectious Diseases, 92:190-201, 1938.

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1. Rippen, A. L., and Burgwald, L. H. The Value of Acidifying Milk and Cream Cans From the Standpoint of the Effect Upon Quality. (Abstract) Jour. Dairy Sci. 24:525, 1941; The Effect of Acidified Cans on the Quality of Dairy Products and on the Phosphatase Value of Cream and Butter. Milk Plant Monthly. 30 (11): 55, 56, 58, 59, 1941.
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3. Smith, Hiram P. Variations in Color, Flavor, and Body Types of Ice Cream as Affecting Consumer Preference. Confectionery and Ice Cream World, February, 1938.
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6. Warner, James N. The Use of Resazurin in Determining the Sanitary Qualities of Milk and Ice Cream. Dairy World, February, 1938.

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1. Adams, Joseph, and Parfitt, E. H. Some Factors Influencing the Amount of Mold Mycelia in Butter. Jour. of Dairy Sci. 22: 367-374, 1939.
2. Tomlinson, Albert S. A Study of Oxidized Flavor. American Milk Review, February, 1940.
3. Larson, R. A., and Lucas, P. S. A Method for Calculating the Baume Reading of Condensed Ice Cream Mixes. Jour. Dairy Sci. 23:229-244, 1940.
4. Dahle, C. D., and Rivers, P. W. Protein Stability of Ice Cream Mixes and Its Effect on Certain Properties. Ice Cream Trade Journal, October, 1940.
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6. Openlander, H. F., and Erb, J. H. The Use of Frozen Condensed Milk in Ice Cream. Proc. 38th Ann. Conv. Internat'l. Assoc. Ice Cream Mfrs. Vol. II, Cleveland, October, 1938.

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2. Harris, W. C., and Hammer, B. W. Effect of Various Bacteria on Flavor of Cheddar Cheese Made From Pasteurized Milk. Jour. Dairy Sci. 23: 701, 1940.
3. MacCurdy, Robert D., and Trout, G. M. The Effect of Holder and Flash Pasteurization on Some Flavors of Milk. I. The Effect of Miscellaneous Flavors Common to Commercial Raw Milk. II. The Effect of Corn and Alfalfa Silage Flavors. Jour. Dairy Sci. 23: 843 and 23: 455, 1940.
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1. Doan, F. J., and Mykleby, R. W. A Critical Study of the United States Public Health Service Definition for Homogenized Milk With Some Recommendations. Jour. Dairy Sci. 26: 893-907, 1943.

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1. Marland, R. E., and Gould, I. A. Accuracy of the Mojonnier Method of Fat Determination as Influenced by Variations in the Type and Quantity of Solvents. American Butter Review, June and July, 1944.

1942-1946

(No Fellowships due to World War II)

1947

1. Tobie, Alan F., and Spencer, L. A Comparative Study of Cost Determination in the Fluid Milk Industry. (Unpublished)

1948

1. Shiffermiller, William E., Carleton, W. M., and Farrall, A. W. A Time and Motion Analysis of the Cleaning Operation in Milk Plants. Milk Plant Monthly 13 (1): 8, 10, 12, 14, 16, 62, 63. 1951.
2. Moore, Donald R., Tracy, P. H., and Ordal, Z. John. Permanent Pipe Lines for Dairy Plants. (In process)

1949

1. Graham, Dee M. Bacteriophage. (Field of investigation)
2. Hunt, Roger W., and Hankinson, D. J. The Effect of Applied Electrical Potential on Oxidized Flavor in Milk. (Unpublished)

1950

1. Sandine, William E. (Research started in 1951)
2. Gilmore, Thomas E. (Research started in 1951)
3. Parkin, Willis E. (Research started in 1951)

SOME EQUIPMENT AND MATERIALS IN A MODERN, WELL EQUIPPED DAIRY PRODUCTS' JUDGING LABORATORY

A well equipped laboratory for judging dairy products is conducive not only to more and better research into the quality of dairy products but also enables the instructor to accomplish more effective teaching with considerably less preparation. The lists of equipment and materials included herewith are not complete by any means but serve merely as a guide in setting up a dairy products judging laboratory.

GENERAL EQUIPMENT

Quantity	Item
3	tables, 2′ x 5′ or 6′, stainless steel, on casters
1	demonstration table, 1½′ x 2½′, on casters
24	chairs, folding
3	cuspidors, dentist type
4	waste receptacles, metal construction
1	cheese cloth, 20 yards
1	parchment paper, 18″ roll
2	racks paper towels, on wall
12	boxes cleansing tissue, folded
1	set score cards, ample supply for each product
1	electric refrigerator, 9 cu. ft.
6	wax pencils
12	lead pencils
6	thermometers (dairy floating)
1	set dairy product quality illustrative material: lantern slides, transparencies, film, prints, charts
1	projection apparatus: slides, film, projection screen
1	blackboard
1	box chalk
2	erasers, blackboard
1	carboy distilled water
1	pkg. sodium chloride

ADDITIONAL EQUIPMENT FOR JUDGING

Quantity	Item
1. Butter	
24	butter triers, plated or stainless steel, 12″-15″
3	box opener
2. Cheese	
24	cheese triers, plated or stainless steel, 4½″ to 5″
2	cheese knives
500	plates, 8″, paper
3. Milk	
1	ice pick for removing bottle closures
48	petri dishes
12	sediment testers, several types
1	assortment of used sediment discs, in petri dishes
1000	sediment discs, unused
1000	tags, duplicate or triplicate numbered
1000	bottle closures, plain plug-type
1	complete assortment of various type milk bottles
1	assortment of milk bottles showing defects
1	assortment of machine-capped milk bottles illustrating the various bottle closures
1	complete assortment of paper milk containers
100	beakers, 100-ml., pyrex low form
1000	drinking cups, Dixie
1000	drinking cups, Vortex

4. Ice cream

2	ice cream cabinets, 6-hole, mounted on dollies
12	ice cream dippers, medium size
1000	spoons, wooden or fibre, for individual sampling
500	plates, 4", individual-service, paper

5. Evaporated and condensed milk

12	spatulas, black plastic
24	beakers, 500-ml., pyrex, low form
24	beakers, 1000-ml., pyrex, low form
2	can openers

6. Dry milk

1	Dumore electric mixer, or Waring food blender
1	Balance, "solution," metric

THE DAIRY PRODUCTS GRADING SERVICE

of

The United States Department of Agriculture
War Food Administration
Office of Distribution
Dairy and Poultry Branch
Inspection and Grading Division

Henry G. F. Hamann, Chief
B. J. Ommodt, Assistant Chief

The dairy and poultry products grading service conducted by the Dairy and Poultry Branch of the Office of Distribution, War Food Administration, operated in accordance with an Act of Congress authorizing the Secretary of Agriculture (the authority as vested in the War Food Administrator) either independently or in co-operation with other branches of the Federal Government, State agencies, or other organizations, tc certify the class, quality and condition of various farm products.

The grading service being provided in practically all states under a co-operative agreement with the State Department of Agriculture and/or the Extension Service of the State College of Agriculture, the graders being employees of the Office of Distribution of the War Food Administration. In some instances, however, employees of the State Department of Agriculture or the State College of Agriculture are utilized for grading work on a reimbursable basis. For this service (operated on a self-sustaining basis) fees and charges collected should be sufficient to pay salaries and expenses of the grading personnel.

The list of dairy products graded includes creamery butter, American Cheddar cheese, American process cheese, Swiss cheese, evaporated milk, condensed milk, nonfat dry milk solids and dried whole milk. Grading to be in accordance with the official standards promulgated by the War Food Administrator for each product, or in accordance with tentative standards approved by the Director of the Office of Distribution, War Food Administration. Products were also graded in accordance with Federal specifications adopted by the Federal Specifications Board. However, gradings made on the basis of these specifications were confined to products purchased by Federal agencies under contract.

The grading service for dairy and poultry products was established in 1919 at the following terminal markets: New York, Boston, Philadelphia, Washington, Chicago, Los Angeles, San Francisco, Portland, and Seattle. The service has expanded gradually until available in all terminal markets and at shipping points throughout the Nation. The growth occurred since its inauguration can be attributed to the favorable recognition given to the service by the industry and to the increased demand for federally graded products.

This service was well established prior to the inauguration of the Nation-wide Government war purchase programs and the Inspection and Grading Division was fully able to cope with the expanded demand for its service with comparatively little dislocation of its normal functions; however, with the inception early in 1942 of the extensive Government purchase programs for dairy products, further expansion of the service became necessary in order to handle the grading of millions of pounds of dairy and poultry products purchased under these programs. In many instances the standards included requirements for chemical and bacteriological analysis. These purchase requirements necessitated laboratory service on a large scale operation. Consequently, War Food Administration laboratories were established at Chicago, San Francisco, and Seattle. Later, the work of these laboratories was largely confined to analyzing products offered to Government Agencies to determine compliance with contract specifications.

Dealers and manufacturers alike recognize the value of an impartial Federal grading service, since it provides an equitable basis for settlement between seller and buyer. It also provides useful information to the manufacturer which he may employ to good advantage in standardizing his product. Retailers also recognize the value of merchandising federally graded and labeled products and therefore make extensive use of the service. The consumer in buying federally graded and labeled products is assured of the values represented by the grade designation.

Packaging and labeling of a federally graded product include its identification by a certificate of quality placed in the package or printed on the package itself. The U. S. grade, clearly indicated on the certificate of quality, serves the ultimate purchaser well. Further requirements stipulate that the labeled product shall be packaged under supervision of a bonded supervisor of packaging. In the case of butter, the product is also subjected to a keeping-quality test to assure additional protection to the consumer.

OFFICIAL UNITED STATES STANDARDS FOR GRADES OF CREAMERY BUTTER

Reprinted from the Federal Register, Volume 8, Number 22, Washington, February 2, 1943

TITLE 7 — AGRICULTURE

Chapter I — Food Distribution Administration[1]

Subchapter C — Regulations Under the Farm Products Inspection Act

Part 63 — Official United States Standards for Grades of Creamery Butter[2]

By virtue of the authority vested in the Secretary of Agriculture by the provision in the act of Congress entitled "An Act Making Appropriations for the Department of Agriculture for the fiscal year

[1] Formerly Agricultural Marketing Association.

[2] These standards supersede the U. S. standards for quality of creamery butter effective April 1, 1939, contained in Part 55, §§ 55.41 to 55.48, inclusive.

ending June 30, 1943, and for other purposes" (56 Stat. 664702), approved July 22, 1942, authorizing an inspection service for farm products, I, Claude R. Wickard, Secretary of Agriculture, do prescribe and promulgate the following standards for grades of creamery butter, that shall be employed for the grading and certification of creamery butter by official graders of the United States Department of Agriculture, to be effective on February 1, 1943, and thereafter unless amended or superseded by standards hereafter prescribed and promulgated under such authority. These standards[3] shall supersede all standards for creamery butter previously promulgated.

§ **63.1 Terms defined.** For the purpose of the United States standards for grades of creamery butter:

(a) **Butter.** Butter shall be the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter, and containing not less than 80 percent by weight of milk fat, all tolerance having been allowed for.[4]

(b) **Creamery butter.** Creamery butter shall be butter manufactured in a commercial creamery.

§ **63.2 Nomenclature of U. S. Grades.** The nomenclature of the U. S. Grades of Creamery Butter shall be as follows: U. S. Grade AA or U. S. 93 Score, U. S. Grade A or U. S. 92 Score, U. S. Grade B or U. S. 90 Score, U. S. Grade C or U. S. 89 Score, U. S. Cooking Grade, and No Grade.

§ **63.3 Basis for determination of U. S. Grades.** The basis for the determination of the U. S. Grades of creamery butter, except "No Grade," shall be as follows:

(a) The flavor shall be classified in accordance with § 63.4.

(b) The defects in body, color, and salt shall be rated in accordance with § 63.5.

(c) The relation of the U. S. Grade of the butter to the flavor classification of it, as affected by total defects in body, color, and salt, shall be determined in accordance with § 63.6.

§ **63.4 Classification of flavors in creamery butter.** Various identified flavors[5] in butter shall be classified as follows:

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[3] These standards shall not excuse failure to comply with the provisions of the Federal Food, Drug, and Cosmetic Act.

[4] In conformity with an act of Congress approved March 24, 1923.

[5] When more than one flavor is discernible in a sample of butter, the flavor classification of the sample shall be established on the basis of the flavor that carries the lowest classification.

Identified flavors:	Flavor classification
Fine, highly pleasing	AA
Slightly normal feed	AA
Definitely cooked	AA
Pleasing and desirable	A
Slightly coarse-acid cream	A
Slightly smothered	A
Slightly heated (summer defect)	A
Slightly aged (butter)	A
Slightly storage	A
Slightly bitter	A
Slightly flat	A
Definitely normal feed	A
Definitely cooked	A
Slightly weedy (common)	B
Slightly musty	B
Slightly rape, cabbage, turnip	B
Slightly woody	B
Definitely old-cream flavor	B
Definitely coarse-acid cream	B
Definitely acidy	B
Definitely utensil	B
Definitely scorched	B
Definitely neutralizer	B
Definitely storage	B
Definitely aged (butter)	B
Definitely greasy	B
Definitely bitter	B
Slightly obnoxious weeds	C
Slightly onion or garlic	C
Definitely scorched-neutralizer	C
Definitely sour	C
Definitely fruity	C
Definitely yeasty	C
Definitely cheesy	C
Definitely alkaline	C
Definitely oily	C
Definitely metallic	C
Definitely cabbage, rape, turnip	C
Definitely weedy (common)	C
Definitely musty	C
Definitely stale	C
Definitely barny	C
Definitely obnoxious weeds	[1]CG
Definitely onion or garlic	CG
Definitely fishy	CG
Pronouncedly yeasty	CG
Pronouncedly fruity	CG
Pronouncedly cheesy	CG
Pronouncedly alkaline	CG
Pronouncedly stale	CG

[1] CG indicates "Cooking Grade."

§ 63.5 Ratings for defects in body, color, and salt. The ratings for defects in body, color, and salt shall be established in accordance with the following:

(a) Gummy, leaky, spongy or weak, mealy, crumbly, or sticky body, wavy color, color specks, and sharp salt shall be rated for defects as follows:

Defects:	Rating
Slight	½
Definite	1

(b) Ragged-boring, grainy, and streaked or mottled shall be rated for defects as follows:

Slight	1
Definite	2

(c) High color (unnatural) shall be rated for defects as follows:

Pronounced	1

(d) Gritty salt shall be rated for defects as follows:

Slight	1
Definite	2

§ 63.6 Relation of U. S. Grade of butter to the flavor classification, as affected by total defects in body, color, and salt. The relation of the U. S. Grade of an individual sample of butter to the flavor classification of it, as affected by total defects in body, color, and salt shall be as follows:

(a) When the total defects in body, color, and salt do not exceed the permitted total defects, which is one-half (½) for butter having a flavor classification of AA, A, or B and one and one-half (1½) for butter having a flavor classification of C, the U. S. Grade of the butter shall be the same as the flavor classification. (See examples 1, 6, 11, 16, and 17 in Table I.)

(b) When the total defects in body, color, and salt exceed the permitted total defects for butter having a flavor classification of AA, A, or B by either one-half (½) or one (1), the U. S. Grade of the butter shall be one grade below the flavor classification; when the total defects for body, color, and salt in such butter exceed the permitted total defects by one and one-half (1½) or two (2), the U. S. Grade of the butter shall be two grades below the flavor classification. (See examples 2, 3, 7, 8, 12, and 13; also examples 4, 5, 9, 10, 14, and 15 in Table I.)

(c) When the total defects in body, color, and salt exceed the permitted total defects for butter having a flavor classification of C by one and one-half (1½) the U. S. Grade of the butter shall be U. S. Cooking Grade. (See examples 18 and 19 in Table I.)

§ 63.7 Specifications for U. S. Grades of creamery butter.[7] The specifications for the U. S. Grades of creamery butter are as follows:

U. S. Grade AA or U. S. 93 Score butter shall possess a fine, highly pleasing flavor. It may possess a slightly normal feed or a definitely cooked flavor. It is made from sweet cream or cream of low natural acid to which a culture (starter) may or may not have been added. The permitted total defects in body, color, and salt are limited to one-half (½).

[7] The basis for determination of the U. S. Grade of an individual churning or sample of creamery butter with respect to its flavor classification, total defects in body, color, and salt, and the relation of the U. S. Grade to the flavor classification as affected by the total defects in body, color, and salt is stated in Sections 63.4, 63.5, and 63.6 of these standards.

Examples of the Relation of U. S. Grade to Flavor Classification and Total Defects in Body, Color, and Salt

Example No.	Flavor Classification	Defects			Total Defects	Permitted Total Defects	Defects in Excess of Total Permitted	U. S. Grade or Score
		Body	Color	Salt				
1	AA	½	0	0	½	½	0	AA or U. S. 93.
2	AA	0	1	0	1	½	½	A or U. S. 92.
3	AA	1	0	½	1½	½	1	A or U. S. 92.
4	AA	1	1	0	2	½	1½	B or U. S. 90.
5	AA	1	1	½	2½	½	2	B or U. S. 90.
6	A	½	0	0	½	½	0	A or U. S. 92.
7	A	0	1	0	1	½	½	B or U. S. 90.
8	A	1	0	½	1½	½	1	B or U. S. 90.
9	A	1	1	0	2	½	1½	C or U. S. 89.
10	A	1	1	½	2½	½	2	C or U. S. 89.
11	B	½	0	0	½	½	0	B or U. S. 90.
12	B	0	1	0	1	½	½	C or U. S. 89.
13	B	1	0	½	1½	½	1	C or U. S. 89.
14	B	1	1	0	2	½	1½	CG.[1]
15	B	1	1	½	2½	½	2	CG.[1]
16	C	1	0	0	1	1½	0	C or U. S. 89.
17	C	1	½	0	1½	1½	0	C or U. S. 89.
18	C	1	1	0	2	1½	½	CG.[1]
19	C	1	1	½	2½	1½	1	CG.[1]

[1] CG indicates "Cooking Grade."

U. S. Grade A or U. S. 92 Score butter shall possess a pleasing and desirable flavor. It may possess any of the following flavors to a slight degree: Coarse-acid, smothered, flat, heated (summer defect), bitter, aged (butter) and storage, or a normal feed and cooked flavor of a definite degree. The permitted total defects in body, color, and salt are limited to one-half (½) unless the flavor classification permits these defects to exceed one-half (½). Butter that has a flavor classification of AA and total defects in body, color, and salt which exceed one-half (½) but do not exceed one and one-half (1½) shall be U. S. Grade A or U. S. 92 Score.

U. S. Grade B or U. S. 90 Score butter may possess any of the following flavors to a slight degree: Weedy, musty, rape, cabbage, turnip, and woody or any of the following flavors of a definite degree: Old-cream flavor, coarse-acid-cream, acidy, utensil, scorched, neutralizer, storage, aged (butter), greasy and bitter. The permitted total defects in body, color, and salt are limited to a total of one-half (½) unless the flavor classification permits these defects to exceed one-half (½). Butter that has a flavor classification of AA and total defects in body, color, and salt which exceed one-half (½) but do not exceed two and one-half (2½) shall be U. S. Grade B or U. S. 90 Score. Butter that has a flavor classification of A and total defects in body, color, and salt which exceed one-half (½) but do not exceed one and one-half (1½) shall be U. S. Grade B or U. S. 90 Score.

U. S. Grade C or U. S. 89 Score butter may possess any of the following flavors to a slight degree: Obnoxious weeds and onion or garlic or any of the following flavors of a definite degree: Scorched-neutralizer, sour, fruity, yeasty, cheesy, alkaline, oily, metallic, cab-

bage, turnip, rape, weedy, musty, stale, and barny. The permitted defects in body, color, and salt are limited to a total of one and one-half (1½) unless the flavor classification permits these defects to exceed one and one-half (1½). Butter that has a flavor classification of A and total defects in body, color, and salt which exceed one and one-half (1½) but do not exceed two and one-half (2½) shall be U. S. Grade C or U. S. 89 Score. Butter that has a flavor classification of B and total defects in body, color, and salt which exceed one-half (½) but do not exceed one and one-half (1½) shall be U. S. Grade C or U. S. 89 Score.

U. S. Cooking Grade butter may possess any of the following flavors of a definite degree: Obnoxious weeds, onion or garlic, and fishy; or any of the following flavors of a pronounced degree: Yeasty, fruity, cheesy, alkaline, and stale. Defects in body, color, and salt are not limited in this grade. Butter that has a flavor classification of B or C and total defects in body, color, and salt of two (2) or more shall be U. S. Cooking Grade.

No Grade: Butter that possesses any of the following flavors or contains any of the substances listed under "conditions" or is below the requirements of the U. S. Cooking Grade shall be classified as "No Grade."

Conditions:

Mold.
Grains of sand.
Splinters of wood.
Specks of rust
Other foreign materials.

Flavors:

Pronouncedly fishy.
Surface taint.
Limburger.
Tallowy.
Rancid.
Paint or varnish.
Gasoline, kerosene, or fly spray.
Chemical.

In testimony whereof I have hereunto set my hand and caused the official seal of the Department of Agriculture to be affixed in the City of Washington this 30th day of January, 1943.

[Seal]

CLAUDE R. WICKARD,
Secretary of Agriculture.

[F. R. Doc. 43-1642; Filed, February 1, 1943; 11:11 a. m.]

U. S. Government Printing Office: 1943 O-509729

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UNITED STATES STANDARDS FOR GRADES OF CHEDDAR CHEESE

(15 F.R. 8233)

§ 45.1 Cheddar cheese. "Cheddar cheese" is synonomous with "cheese" and is made from cow's milk with or without the addition of coloring matter and with common salt, contains not more than 39 percent moisture, and, in the water-free substance, contains not less than 50 percent milk fat. The term "cheddar cheese" shall be deemed to include cheese of the granular or stirred curd type.

§ 45.2 Types of packaging. The following are the types of packaging for cheddar cheese:

(a) **Bandaged and paraffin-dipped.** The cheese is bandaged and dipped in refined paraffin. The starch circles may be left on or removed prior to paraffining. The paraffin coating is a continuous, unbroken, and uniform film covering the entire surface of the bandaged cheese.

(b) **Rindless (cured-in-package).** The cheese is tightly wrapped in a transparent wrapper which will not impart any color or objectionable odor or flavor to the cheese or interfere with the natural aging of the cheese. The wrapper is sealed with a minimum overlap of one-half inch. When pressure-sensitive tape is used for such sealing, the taped seams overlap at least one inch. The wrapper is of sufficiently low permeability to water vapor and oxygen so as to prevent the formation of rind during the curing and holding periods.

§ 45.3 Nomenclature of U. S. Grades. (a) The nomenclature of the U. S. grades is as follows: (1) U. S. grade AA; (2) U. S. Grade A; (3) U. S. Grade B; and (4) U. S. Grade C.

(b) **Basis for determination of U. S. Grades.** The U. S. grades of cheddar cheese shall be determined on the basis of flavor and odor, body and texture, color, and finish and appearance as follows:

(1) **U. S. Grade AA.** U. S. Grade AA cheddar cheese conforms to the following requirements and specifications:

(i) **Flavor and odor.** Is free from objectionable flavors and odors.

(ii) **Body and texture.** A plug drawn from the cheese: appears solid, compact, and close, although it may have a few small but no large mechanical openings; is free from sweet or Swiss holes, yeast holes, and gas holes of any kind; and is translucent.

(iii) **Color.** May be uncolored or of uniform medium color.

(iv) **Finish and appearance — (a) When bandaged and paraffin-dipped.** Is free from surface defects (including, but not being limited to, cracks in the rind, soft spots, rind rot, and scaly paraffin) which may cause deterioration of the cheese; is not huffed; is not lopsided; is free from high edges; and has a coating of paraffin that adheres firmly to the surface of the cheese. The bandage is evenly placed on the ends of the cheese and is free from unnecessary overlapping and wrinkles.

(b) **When rindless (cured-in-package).** The cheese is not huffed or lopsided. The wrapper may be slightly wrinkled but is unbroken.

(v) **Specifications applicable to cheese of different ages.**

Fresh or current make	Medium cured	Cured or aged
(a) Flavor: No flavor development.	Flavor: Mild characteristic cheese flavor.	Flavor: Well-developed characteristic cheese flavor.
(b) Body and texture: Firm, smooth, and curdy, or it may be partially broken down if the cheese is over 3 weeks old.	Body and texture: Firm, smooth, and waxy, or it may be slightly curdy or not entirely broken down.	Body and texture: Firm, smooth, and waxy.
(c) Color: No additional requirements.	Color: No additional requirements.	Color: May have tiny white specks.
(d) Finish and appearance: Smooth, bright surface, free from mold underneath the bandage and paraffin or wrapper; may have very slightly soiled surface and surface mold.	Finish and appearance: Smooth surface, free from mold underneath the bandage and paraffin or wrapper; may have slightly soiled surface and surface mold.	Finish and appearance: Smooth surface; may have very slight mold underneath the bandage and paraffin or wrapper and may have slightly soiled surface and moderate surface mold.

(2) **U. S. Grade A.** U. S. Grade A cheddar cheese conforms to the following requirements and specifications:

(i) **Flavor and odor.** Is free from objectionable flavors and odors; but may have slight regional or seasonal feed flavors.

(ii) **Body and texture.** A plug drawn from the cheese: appears practically solid, compact, and close although it may have a few mechanical openings but these are not large and connecting; may not have more than two sweet or Swiss holes; is free from yeast holes and other gas holes; and is translucent.

(iii) **Color.** May be uncolored or medium colored and slightly seamy.

(iv) **Finish and appearance — (a) When bandaged and paraffin-dipped.** Is free from surface defects (including, but not being limited to, cracks in the rind, soft spots, rind rot, and scaly paraffin) which may cause deterioration of the cheese; is not huffed; has a coating of paraffin that adheres to the surface of the cheese; may be slightly lopsided; may have slightly high edges. The bandage may be slightly uneven, overlapped, or wrinkled, but is not burst or torn.

(b) **When rindless (cured-in-package).** The cheese is not huffed but may be slightly lopsided. The wrapper may be slightly wrinkled but is unbroken.

(v) Specifications applicable to cheese of different ages.

Fresh or current make	Medium cured	Cured or aged
(a) Flavor: Practically no flavor development.	Flavor: Mild characteristic cheese flavor; may have a slight acid flavor.	Flavor: Well-developed characteristic cheese flavor; may be slightly bitter or slightly acid.
(b) Body and texture: Firm, smooth and curdy, or may be partially broken down if the cheese is over 3 weeks old.	Body and texture: Reasonably firm, smooth, and waxy; may be slightly curdy or not entirely broken down, or slightly short, mealy, or weak.	Body and texture: Reasonably firm, smooth, and waxy; may be slightly short or mealy, or slightly weak and pasty.
(c) Color: No additional requirements.	Color: No additional requirements.	Color: May have tiny white specks.
(d) Finish and appearance: Smooth, bright surface, free from mold underneath the bandage and paraffin or wrapper; may have very slight soiled surface and surface mold.	Finish and appearance: Smooth surface, free from mold underneath the bandage and paraffin or wrapper; may have slight soiled surface and surface mold.	Finish and appearance: Smooth surface; may have very slight mold underneath the bandage and paraffin or wrapper; may have slight soiled surface and moderate surface mold.

(3) **U. S. Grade B.** U. S. Grade B cheddar cheese conforms to the following requirements and specifications:

(i) **Flavor and odor.** May possess definite off-flavors and odors.

(ii) **Body and texture.** A plug drawn from the cheese: may be loose and open and may have numerous sweet or Swiss holes, scattered yeast holes, and other scattered gas holes.

(iii) **Color.** Is uncolored or of medium color or high color; may be seamy, slightly acid cut or faded, slightly wavy, and slightly mottled.

(iv) **Finish and appearance — (a) When bandaged and paraffin-dipped.** May have a rough or unattractive appearance; have scaly paraffin; be slightly huffed; and be lopsided, but not to the extent the lid will not fit squarely on the box; is solid, free from soft spots, rind rot, cracks and openings of any kind. The bandage may be uneven, overlapped, or wrinkled, but is not burst or torn. There is no indication that mold has entered the cheese.

(b) **When rindless (cured-in-package).** The cheese may be slightly huffed and slightly lopsided. The wrapper may be slightly wrinkled but is unbroken.

(v) **Specifications applicable to cheese of different ages.**

Fresh or current make	Medium cured	Cured or aged
(a) Flavor: May be slightly acid, bitter, feed, fruity, metallic, utensil, whey taint, and yeasty. May be definitely old milk.	Flavor: May be definitely acid, bitter, feed, fruity, metallic, old milk, utensil, whey taint, and yeasty.	Flavor: May be definitely acid, bitter, feed, fruity, metallic, old milk, utensil, whey taint, and yeasty.
(b) Body and texture: May have a weak body but not pasty; may be partially broken down; may have a firm, dry and coarse, short, mealy body or a corky body.	Body and texture: May have a weak, pasty body, but not soft and smeary; may have a firm, short, mealy body or a slightly corky body.	Body and texture: May have a weak, pasty body, but not extremely soft and smeary; may have a firm, short, mealy body.
(c) Color: No additional requirements.	Color: No additional requirements.	Color: May have tiny white specks.
(d) Finish and appearance: May have slight soiled surface and surface mold. May have very slight mold underneath the bandage and paraffin.	Finish and appearance: Surface may be soiled and may have slight surface mold; may have slight mold underneath the bandage and paraffin or wrapper.	Finish and appearance: Surface may be soiled and may have moderate surface mold; may have slight mold underneath the bandage and paraffin or wrapper.

(4) **U. S. Grade C.** U. S. Grade C cheddar cheese conforms to the following requirements and specifications:

(i) **Flavor and odor.** It may possess pronounced off-flavors and odors.

(ii) **Body and texture.** May be loose and open. May have sweet or Swiss holes, yeast holes, and other gas holes.

(iii) **Color.** May be uncolored, of medium color, or of high color. May be acid cut or faded, wavy, seamy, and mottled. It is not wavy or mottled to the extent that it is unappetizing.

(iv) **Finish and appearance — (a) When bandaged and paraffin-dipped.** May have a rough, unattractive appearance. May have scaly paraffin, may be huffed and lopsided, and may have soiled surface and surface mold. The rind may have very slight rind rot, cracks, and openings. The bandage is not burst or torn. May have mold underneath the bandage and paraffin, but there is no indication of mold having entered the cheese.

(b) **When rindless (cured-in-package).** The cheese may be lopsided and slightly huffed. The wrapper may be wrinkled and have a soiled surface but is unbroken.

(v) Specifications applicable to cheese of different ages.

Fresh or current make	Medium cured	Cured or aged
(a) Flavor: May be definitely acid, bitter, feed, fruity, whey taint, weed, metallic, utensil, yeasty, and sour.	Flavor: May have pronounced off-flavors, such as, acid, bitter, feed, fruity, whey taint, weed, metallic, utensil, yeasty, and sour. Flavor shall not be offensive.	Flavor: May have pronounced off-flavors, such as, acid, bitter, feed, fruity, whey taint, weed, metallic, utensil, yeasty, and sour. Flavor shall not be offensive.
(b) Body and texture: May be weak and pasty but not soft and smeary; may have a firm, coarse, short, mealy body, or a definitely corky body.	Body and texture: May be weak and pasty but not extremely soft and smeary; may have a firm, coarse, short, mealy body, or a slightly corky body.	Body and texture: May be weak and pasty but not extremely soft and smeary; may have a firm, short, coarse, mealy body.
(c) Color: No additional requirements.	Color: No additional requirements.	Color: No additional requirements.
(d) Finish and appearance: Rindless is free of mold underneath the wrapper.	Finish and appearance: Rindless may have very slight mold underneath the wrapper.	Finish and appearance: Rindless may have slight mold underneath the wrapper.

§ 45.4 Explanation of terms — (a) with respect to packaging — (1) **Paraffin.** Refined paraffin, amorphous wax, or a combination of both.

(b) **With respect to flavor and odor.** — (1) **Slight; slightly.** Detected only upon critical examination.

(2) **Definite; definitely.** Not intense but detectable.

(3) **Pronounced.** So intense as to be easily identified.

(4) **Offensive.** Foul or obnoxious.

(5) **Mild.** Not sharp or strong.

(6) **Practically no flavor development.** Slight characteristic cheese flavor.

(7) **Well-developed.** Characteristic and pronounced.

(8) **Acid.** Sharp and puckery to the taste.

(9) **Feed.** Feed flavors (such as alfalfa, sweet clover, silage, or similar feed) in milk carried through into the cheese.

(10) **Fruity.** A sweetish fruit flavor or flavor characteristic of an uncleaned whey tank.

(11) **Regional or seasonal feed flavors.** Flavors of feed that are commonly present in milk at certain times of the year or in certain regions.

(12) **Sour.** Strongly acid and strong sour taste and aroma.

(13) **Utensil.** Suggestive of improper or inadequate washing and sanitizing of milking machines, utensils, or factory equipment.

(14) **Weed.** Weed flavors (such as peppergrass, french weed, wild onion, or garlic) that may be present in cheese derived from milk of cows that have eaten weedy hay or have grazed on weed infested pastures.

(15) **Whey taint.** Mildly acid and aroma characteristic of fermented whey.

(16) **Yeasty.** Indicating yeast fermentation.

(c) **With respect to body and texture** — (1) **Broken down.** Changed from a firm smooth, or coarse curdy or rubbery condition to a waxy condition similar to that of cold butter or to a mealy, or pasty condition.

(2) **Corky.** Dry and coarse and crumbly; springy and does not mold together.

(3) **Dry and coarse.** Feels rough and sandy.

(4) **Firm.** Feels solid; not soft or weak.

(5) **Gas holes.** Holes caused by gas fermentation.

(6) **Loose and open.** Mechanical openings coursing the full length of the plug; the plug is not firm.

(7) **Mealy or short.** No elasticity to the plug; when worked between the fingers, the plug feels and looks like corn meal; is not waxy and does not mold well.

(8) **Mechanical openings.** Irregular shaped openings (regardless of the number and size) caused by poor workmanship and not by gas fermentation.

(9) **Pasty.** When worked between the fingers, becomes sticky.

(10) **Pin holes.** So called because the holes are very small and give the appearance of pin pricks.

(11) **Reasonably firm.** Slightly weak but not to the extent of materially injuring the keeping quality of the cheese.

(12) **Slightly curdy or not entirely broken down.** Smooth but firm; when worked between the fingers, is curdy and not waxy.

(13) **Smooth.** Feels silky; not dry and coarse or rough.

(14) **Solid, compact, and close.** Practically free from openings of any kind.

(15) **Sweet or Swiss holes.** Spherical openings, glossy in appearance; usually about the size of BB shots; also referred to as shot holes.

(16) **Waxy.** When worked between the fingers molds well like wax or cold butter.

(17) **Weak.** When worked between the fingers, requires little pressure to mash.

(18) **Yeast holes.** Slit-like openings, elliptical in shape; often referred to as fish-eyes.

(d) **With respect to color** — (1) **Acid cut or faded.** Bleached appearance.

(2) **High Color.** Deep yellow or reddish.

(3) **Medium color.** Deep straw or amber.

(4) **Seamy.** White, thread-like lines.

(5) **Tiny white specks.** Specks resembling grains of salt scattered throughout the cheese.

(6) **Uncolored.** Absence of artificial coloring.

(e) **With respect to finish and appearance** — (1) **Bandage evenly placed.** Edges of bandage overlap about one inch.

(2) **Bandage fairly evenly placed.** Edges of bandage overlap from about one inch to one and one-half inches.

(3) **Cracks in the rind.** Openings of any kind in the rind.

(4) **Huffed.** Swollen because of gas fermentation.

(5) **Rind.** Hard coating caused by the dessication of the surface of the cheese.

(6) **Rind rot.** Soft spots, on the rind, that are discolored, decayed, or decomposed.

(7) **Scaly paraffin.** Thick, brittle coating of paraffin that breaks and peels off in the form of scales.

(8) **Slightly high edges.** May have a rim or high edge but not high enough to fold over when the cheese is placed on the shelf.

(9) **Surface mold.** Mold on the paraffin or wrapper of the cheese.

(10) **Paraffin that adheres to the surface of the cheese.** Coating of paraffin not broken or peeled off but may have some checks or be slightly bruised.

(11) **Unnecessary overlapping.** More bandage on one end than on the other.

(12) **Paraffin that adheres firmly to the surface of the cheese.** Coating of paraffin not cracked, broken, bruised, or loose.

(13) **Slightly soiled surface and surface mold.** Soiled surface or surface mold that can be removed without injuring the appearance or finish of the cheese.

(14) **Slightly soiled surface and moderate surface mold.** Soiled surface or surface mold that can be removed without jeopardizing the preservation of the cheese or injuring the commercial appearance of the cheese.

Done at Washington, D. C., this 29th day of November, 1950, to become effective 30 days after publication in the FEDERAL REGISTER. These U. S. Standards shall, upon becoming effective, supersede Tentative U. S. Standards for Grades of American Cheddar Cheese, approved April 24, 1943, and reissued December 6, 1945.

[Seal] JOHN I. THOMPSON,
Assistant Administrator, Production and Marketing Administration.

[F. R. Doc. 50—10973; Filed, Dec. 1, 1950; 8:54 a. m.]

TENTATIVE U. S. STANDARDS FOR GRADES OF SWISS CHEESE

These tentative U. S. standards were used by the Office of Distribution in grading Swiss cheese beginning May, 1944.

Definition[1]

These standards are for the food product commonly known as Swiss, drum Swiss, or block Swiss cheese. It usually contains not more than 40 percent moisture and its solids usually contain not less than 45 percent milk fat. It is made by substantially the following process:

The milk may or may not be pasteurized, but is usually clarified. It may be standardized to adjust the fat content by removing a portion of the fat or by adding skimmilk. The milk is warmed, when necessary, and subjected to the action of harmless lactic acid forming bacteria which may be present in the milk or which may be added. A propionic acid forming organism may also be added. Sufficient rennet is added to cause setting to a semi-solid mass. The mass is so cut, stirred, and heated as to promote the separation of whey and curd. The final cooking temperature is about 127° F. When the curd is sufficiently firm it is allowed to settle in the kettle and is then removed from the whey with a dipping cloth. The mass of curd is then placed in a cheese hoop or block form on the press table, and put under pressure for a period of about 16 hours. The cheese is removed from the press table and immersed in brine for a period of about 3 days; then it is left in a cold room for about 12 days. It is then held in a curing room at a temperature of about 75° F. for a period of about 6 weeks or until the "eyes" have formed in the body of the cheese. It usually is then held at a lower temperature for further aging.

Nomenclature of U. S. Grades

The U. S. Grades of Swiss cheese shall be known as follows:

U. S. Grade AA or U. S. Fancy
U. S. Grade A or U. S. No. 1
U. S. Grade B or U. S. No. 2
U. S. Grade C or U. S. No. 3
U. S. Grade D or U. S. Grinders
U. S. Grade E or U. S. Undergrade

Basis of Determination for U. S. Grade

The grade of cheese shall be determined on the basis of its characteristics with respect to flavor, body, eyes and texture, finish and appearance, salt, and color, as set forth below for each grade.

U. S. Grade AA or U. S. Fancy

Flavor. Shall be free from all undesirable flavors and odors.

Current make:	May be flat or deficient in characteristic Swiss cheese flavor.
Cured:	Shall have a well-developed, desirable, characteristic Swiss cheese flavor.

Body. Shall be firm and smooth, and shall not be dry and coarse or spongy.

Current make:	The body shall be meaty, resilient and pliable. It may not be entirely broken down.
Cured:	The body shall be meaty, pliable and entirely broken down.

[1]Grading certificates shall not be deemed to represent that the product graded meets this definition and shall not excuse failure to comply with the Federal Food, Drug and Cosmetic Act or any other Federal regulation.

Eyes and Texture. The eyes shall be round or slightly oval, with smooth, shiny walls. A majority of the eyes on a plug shall be not less than three-fourths of an inch in diameter, evenly distributed, showing an average of not less than one and not more than five eyes on a plug. The cheese shall be free from glass, pinholes, and over-developed eyes. It may have picks and checks located within three-fourths of an inch of the surface but only an occasional pick located more than three-fourths of an inch from the surface.

Finish and Appearance. Shall be well shaped with sound, dry rind.

Current make: The surface shall be clean and smooth.

Cured: The surface may be slightly rough and slightly moldy.

Salt. Shall be uniform.

Current make: It may be deficient in salt.

Cured: It shall not be deficient in salt.

Color. Shall be uniform.

U. S. Grade A or U. S. No. 1

Flavor. Shall be free from undesirable flavors and odors, except that it may have slight seasonal regional feed flavors.

Current make: May be flat or deficient in characteristic Swiss cheese flavor.

Cured: Shall have a characteristic Swiss cheese flavor.

Body. Shall be firm and smooth, and shall not be dry and coarse or spongy.

Current make: The body shall be meaty and pliable. It may not be entirely broken down.

Cured: The body shall be meaty and entirely broken down.

Eyes and Texture. Shall be round or slightly oval with smooth, shiny walls except that an occasional rough or dead eye is allowed. A majority of the eyes on a plug shall not be less than one-half inch in diameter, evenly distributed, showing an average of not less than one and not more than ten eyes on a full plug. The cheese shall be free from glass, pinholes, and over-developed eyes. It may have picks and checks within three-fourths of an inch from the surface but only scattered picks more than three-fourths of an inch from the surface.

Finish and Appearance. Shall be well shaped with sound dry rind.

Current make: The surface shall be clean and smooth.

Cured: The surface may be slightly rough and slightly moldy.

Salt. Shall be uniform.

Current make: It may be deficient in salt.

Cured: It shall not be deficient in salt.

Color. Shall be uniform.

U. S. Grade B or U. S. No. 2

Flavor. Shall not have pronounced undesirable flavors. It may have definite seasonal regional feed flavors.

Current make: May be flat or deficient in characteristic Swiss cheese flavor. It may have only slight undesirable flavors.

Cured: It shall have characteristic Swiss cheese flavor, but it may lack the fineness in flavor required in higher grades; it may have definite undesirable flavors.

Body. Shall not be dry and coarse or spongy.

Current make: The body shall be meaty and pliable. It may be slightly weak.

Cured: The body shall be meaty and entirely broken down. It may be weak.

Eyes and Texture. Shall not be blind. It may be over-set but the majority of the eyes on a plug shall be not less than five-sixteenths of an inch in diameter. The eyes may have a dull glossy appearance but not more than four dead eyes on a plug. It may have some glass but shall pull a full plug. It may have scattered gas holes but it shall not be pinholey or have over-developed eyes. It may have checks and picks.

Finish and Appearance. May be definitely uneven in shape, but the rind shall be sound.

Current make: The surface may be slightly rough and slightly moldy.

Cured: The surface may be rough and slightly moldy.

Salt. Shall be uniform.

Current make: It may be flat or deficient in salt.

Cured: It may be flat or deficient in salt or slightly over-salted.

Color. Shall be uniform.

U. S. Grade C or U. S. No. 3

Flavor. Shall not have strong undesirable flavor. It may have pronounced seasonal, regional feed flavors.

Current make: It may be flat or deficient in characteristic Swiss cheese flavors. It may have definite undesirable flavors.

Cured: It shall have a characteristic Swiss cheese flavor. It may have pronounced undesirable flavors.

Body. Shall not be dry and coarse or spongy.

Current make: The body shall be meaty. It may be broken down and slightly weak.

Cured: The body shall be meaty and entirely broken down. It may be weak.

Eyes and Texture. Shall not be totally blind or totally pinholey. It may be over-set, small eyed, or dead eyed. It may have considerable glass, picks, or checks. It may have over-developed eyes, but they must be less than three inches in diameter.

Finish and Appearance. It may be definitely uneven in shape and have a rough surface but the rind shall be sound.

Salt. Shall be uniform.

Current make: It may be flat or deficient in salt.

Cured: It may be flat or deficient in salt or may be over salted.

Color. Shall be uniform.

U. S. Grade D or U. S. Grinders

Flavor. Shall not be offensive.

Current make: It may have pronounced off-flavors.

Cured: It may have strong off-flavors.

Body. May be dry and coarse or spongy and weak.

Eyes and Texture. It may be totally blind or totally pinholey. It may have glass, checks and picks. It may have over-developed eyes.

Finish and Appearance. May be uneven in shape and have a rough unattractive surface. There shall not be defects in the rind to the extent that more than 25 percent of the cheese is damaged.

Salt. May be uneven, deficient, or over-salted.

Color. May be definitely wavy or mottled or otherwise uneven in color.

U. S. Grade E or U. S. Undergrade.

This grade shall have the same specifications for flavor, body, eyes and texture, finish and appearance, salt and color, as Grade D or Grinders except that the rind may be so defective that more than 25 percent of the cheese is damaged.

Any cheese not meeting the specifications of U. S. Grade E or U. S. Undergrade or better shall be classified as below U. S. Grade.

Explanation of Terms Used to Describe Flavor

Slight:	Of little importance, detected only upon critical examination.
Definite:	Flavors that are not intense but can be identified.
Pronounced:	Flavors that are so intense, they are easily detected, no question as to the character of the flavor.
Strong:	A quick persistent flavor that leaves a disagreeable taste on the palate.
Offensive:	Flavors that are foul, obnoxious.
Characteristic Swiss cheese flavor:	A slightly sweet hazel nut flavor leaving a pleasing taste on the palate.
Undesirable flavors:	Flavors that are foreign to cheese of good commercial quality or that are not commonly present in high grade cheese such as sour, bitter, yeasty, fermented and fruity, or other off-flavors.
Flat:	No flavor, lack of salt.
Lacking in flavor:	No undesirable, and very little, if any, desirable flavor development.
Well-developed:	A characteristic, desirable and pronounced Swiss cheese flavor.
Sour:	Strong, acid flavor and taste.
Bitter:	Distasteful, as detected in the throat, similar to taste of quinine.
Yeasty:	A flavor and aroma indicating yeasty fermentation.
Fermented or fruity:	A sweetish flavor, characteristic of some fruit or uncleaned whey tank. This flavor will usually increase in intensity as cheese ages.
Regional or seasonal feed:	Feed flavors that are commonly present in milk at certain times of the year or in certain sections, such as alfalfa, sweet clover, silage, or any other similar feed.
Off flavor:	Foreign to cheese, difficult to characterize.

Explanation of Terms Used to Describe Body

Broken down:	A change in the body from a firm, smooth or coarse curdy or rubbery condition to a waxy condition like cold butter, or to a mealy or pasty condition.
Dry and coarse:	Feels rough, sandy, not smooth.
Firm:	Feels solid, not soft or weak.
Meaty:	When a plug of cheese from the trier is bent, it will tear and not break short, shows flexibility, not dry or brittle.
Resilient:	The tendency to recover or spring back to its original form when compressed.
Spongy:	A predominance of open area or holes over body or cheese area. Having characteristics of a sponge.
Weak:	Requires little pressure to mash. Not firm.

Explanation of Terms Used to Describe Eyes and Texture

Eyes:	Openings that are round or slightly oval in shape, with smooth even walls that are glossy or velvety varying in size from three-sixteenths to one inch in diameter.
Blind:	No eye formation present.
Small-eyed:	Eyes that are less than five-sixteenths of an inch in diameter.
Overset:	Eyes so numerous within the body of the cheese that they crowd each other leaving only a small portion that is solid. The eyes are usually irregular in size.
Smooth, shiny walls:	Eye walls with a glass-like surface giving an immediate impression of glossy luster.
Dead or rough eyes:	Developed eyes that have completely lost their glossy or velvety appearance, and also may be rough.
Pin holes:	So called because the holes are very small and the cheese has the appearance of having been pricked with a pin.
Picks:	Small irregular or ragged openings within the body of the cheese.
Checks:	Small short cracks within the body of the cheese.
Glass:	Sizeable cracks, usually in parallel layers and usually clean cut, found within the body of the cheese.
Over-developed eyes:	Large holes, commonly known as blow holes, usually in excess of 2 inches in diameter.
Scattered gas holes:	Gas holes very thinly and irregularly dispersed throughout the body of the cheese, ordinarily showing from 3 to 8 holes on a drawn plug.
Current:	Usually from 6 to 8 weeks old but never less than 6 weeks old.
Cured:	Usually more than 6 months old but never less than 10 weeks old.

TENTATIVE U. S. STANDARDS FOR GRADES OF DRIED SKIMMILK AND DRIED WHOLE MILK

The specifications set forth herewith are those on the basis of which the U. S. Food Distribution Administration bought dried milk, starting May 14, 1943.

GENERAL REQUIREMENTS

The following general requirements apply to all classes of dried skimmilk and dried whole milk for human food:

1. The product shall meet all requirements of the Federal Food, Drug, Cosmetic Act, as Amended, and all regulations pursuant thereto.

2. The dried skimmilk shall be made by the drying of sweet freshly separated skimmilk to which no alkali or other chemical has been added. The dried whole milk shall be made by the drying of sweet fresh whole milk to which no alkali or other chemical has been added. All milk used in making the dried skimmilk or dried whole milk shall be heated in the liquid state either before or during the process of manufacture to a temperature of at least 145° F. for 30 minutes, or its equivalent, in terms of bacterial destruction.

3. The plant and plant equipment used in the manufacture of the product shall be of sanitary construction and shall be maintained in proper sanitary condition and operation.

DRIED SKIMMILK SPECIFICATIONS

U. S. Extra Grade: It shall meet the specifications in the following table:

	Spray Not to Exceed	Vacuum Drum Not to Exceed	Atmospheric Roller Not to Exceed
Moisture	4.0%	4.0%	4.0%
Butterfat	1.25%	1.25%	1.25%
Acidity[1]	.15%	.15%	.15%
Solubility Index	1.25 cc.	2.0 cc.	15.0 cc.
Bacteria count[1]	15,000 per cc.	15,000 per cc.	15,000 per cc.
Sediment[2]	Disc. No. 3	Disc. No. 3	Disc. No. 3

[1]Reconstituted basis.
[2]American Dry Milk Institute Standards.

The product shall be of uniform light color and free from any firm lumps or caking. The flavor of the dry or reconstituted product shall be sweet and clean and free from tallowy, scorched, unclean, foreign or other objectionable odors or flavors.

U. S. Standard Grade: It shall meet the specifications in the following table:

	Spray Not to Exceed	Vacuum Drum Not to Exceed	Atmospheric Roller Not to Exceed
Moisture	5.00%	5.00%	5.00%
Butterfat	1.50%	1.50%	1.50%
Acidity[1]	.17%	.17%	.17%
Solubility Index	2.00 cc.	5.00 cc.	15.00 cc.
Bacteria count[1]	50,000 per cc.	50,000 per cc.	50,000 per cc.
Sediment[2]	Disc. No. 4	Disc. No. 4	Disc. No. 4

[1] Reconstituted basis.
[2] American Dry Milk Institute Standards.

The product shall be free from any hard lumps or caking. The dry or reconstituted product may have slight storage, slight scorched or other slight flavor defect.

DRIED WHOLE MILK SPECIFICATIONS

U. S. Extra Grade: It shall meet the specifications in the following table:

	Spray	Vacuum Drum	Atmospheric Roller
Moisture—Not to exceed	2.5%	2.5%	2.5%
Butterfat—Not less than	26.00%	26.00%	26.00%
Acidity[1]—Not to exceed	0.15%	0.15%	0.15%
Solubility Index—Not to exceed	0.5 cc.	2.00 cc.	15.00 cc.
Bacteria[1]—Not to exceed	6,000 per cc.*	6,000 per cc.*	6,000 per cc.*
Sediment[2]—Not to exceed	Disc. No. 3	Disc. No. 3	Disc. No. 3

[1] Reconstituted basis.
[2] American Dry Milk Institute Standards.
*50,000 per gram of dried milk — approximate equivalent.

The dried whole milk shall be of uniform light cream color, free from any brownish color due to overheating and shall show no firm lumps or caking. The flavor of the dried or reconstituted milk shall be sweet and clean, free from any rancid, oxidized, scorched, tallowy, unclean, foreign or other objectionable flavors or odors.

Guarantee: The dried whole milk shall be guaranteed to keep satisfactorily (show not more than slight deterioration in flavor in reconstituted form) for a period of six months, as indicated by representative samples taken by the official sampler and held by Food Distribution Administration at room temperature (averaging approximately 80° F.) for six months if packed in inert gas in one-pound hermetically sealed tins or for three months if packed in suitable friction top tins. (Tins for samples to be furnished by vendor.)

General: Unless otherwise indicated, dried whole milk shall meet the following requirements in addition to the "General Requirements" for all classes of dried milk.

Farm Milk Quality: Only high quality, strictly fresh milk of good flavor, free from foreign or objectionable odors or flavors and of not more than 0.17 percent acidity shall be used. It shall be delivered to the drying plant at least once daily, and shall be handled in equipment properly cleaned and sterilized after each use.

Plant Equipment: It shall be of sanitary construction, of metals that eliminate exposure to copper of heated liquid milk. There shall be adequate provisions for proper washing and sterilization of equipment.

Plant Manufacturing: All milk shall be processed as quickly as possible after being produced and be in dried form within not to exceed 36 hours from the time of production on the farms. The dried product shall be made from original milk as produced, except as it may be altered through standardization by the removal of cream by plant separation, or by the addition of either sweet, freshly plant-separated skimmilk or cream of high quality, or by other necessary processing. The dried produot shall be properly cooled and packed in containers as quickly as possible after drying.

METHODS OF SAMPLING, TESTING AND GRADING

Sampling: All samples shall be representative of the lots and shall be carefully and properly taken according to the instructions issued by the Inspection and Grading Division, Dairy and Poultry Branch.

Solubility Index: 26 grams of a representative well-mixed sample of dried whole milk or 20 grams of dried skim milk and 200 cc. of distilled or filtered water shall be used. The dried milk shall be added to the water at a temperature of exactly 75° F. and agitated for 90 seconds with a Dumore No. 6 electrical mixer or a mixer giving equivalent results. Allow reconstituted sample to stand for a few minutes to permit foam to come to the surface — this period not to exceed a total of 25 minutes from the time of mixing. Remove foam with a spoon, stir sample and immediately pour 50 cc. into a milk sediment tube. Centrifuge tube for 5 minutes at correct speed[1]. Remove supernatant liquid to within a few cc. of the sediment in the bottom of the tube. Add about 25 cc. of distilled water, temperature 75° F., to the sediment tube — shake well to loosen sediment and mix with water. If sediment cannot be broken up with shaking, a twisted metal wire may be used as an aid. Fill the sediment tube to the 50 cc. mark with distilled water at 75° F., mix well and centrifuge for another 5 minutes. Record the amount of sediment in the bottom of the tube as cc. solubility index.

Caution: Directions given must be followed carefully in determining solubility index or reliable results will not be obtained. Not all electrical mixers give the same results and if other than the one specified is used, the approximate difference in results compared to the Dumore No. 6 should be determined. Electrical mixers may be altered to give substantially the same results as the Dumore No. 6, by a change of speed, type of agitator, or by a change in the temperature of water used.

Sediment Test: 50 grams of dried skimmilk or 65 grams of dried whole milk shall be used with 500 cc. of distilled or filtered water. Mix well with an electrical mixer. Allow reconstituted milk to stand a few minutes, stir well and pass through a standard 1¼" sediment filter disc. Determine sediment gradings on dried sediment disc with standard sediment grading discs of the American Dry Milk Institute. When the sediment disc falls between two of the standard discs it is to be graded as the lower number. In case the reconstituted milk will not pass through the sediment disc, 250 cc. shall be allowed to stand in a 20-ounce glass tumbler (with bottom of approximate 2" diameter) for 5 hours, when sediment in the bottom shall be compared with the American Dry Milk Institute sediment tumbler standards for sediment grading.

Bacterial Count: It shall be determined on the reconstituted milk according to the methods given in the latest edition of "Standard Methods for the Examination of Dairy Products," published by the American Public Health Association, using 10 grams of dried skimmilk or 13 grams of dried whole milk to 100 cc. of sterile distilled water.

Moisture: It shall be determined according to the methods given in the latest edition of "Methods of Analysis of the Association of Official Agricultural Chemists" or by the Toluol Method given in the 1942 revision of the American Dry Milk Institute booklet, "The Grading of Dry Milk Solids."

Butterfat: It shall be determined according to the methods given in the latest edition of "Methods of Analysis of the Association of Official Agricultural Chemists" or the Modified Roese-Gottlieb (Mojonnier) Method.

[1] See table given in American Dry Milk Institute booklet, "The Grading of Dry Milk Solids" 1942 revision, for correct speed of centrifuge.

Acidity: It shall be determined on the reconstituted milk using 20 grams of dried skimmilk or 26 grams of dried whole milk with 200 cc. of distilled water in accordance with the following procedure: To 17.6 cc. of the reconstituted product add an equal amount of distilled water and 0.5 cc. (8 to 10 drops) of 0.5% phenolpthalein indicator solution. Titrate with tenth normal sodium hydrate solution until a faint pink color remains for 30 seconds. Dividing the number of cc. of alkali solution used by 20 gives the percentage of acidity as lactic acid.

TENTATIVE STANDARDS FOR TOP QUALITY BULK CONDENSED MILK

Approved by American Bulk Condensed Milk Association

Following are tentative standards approved by the American Bulk Condensed Milk Association for Top Quality Bulk Condensed Milk.

Included is a classification to be known as "specials."

I. Sweetened Condensed Skim Milk

Milk Solids — Shall contain a minimum of 30% milk solids.

Sugar (Sucrose) — Shall contain not less than 42% sugar. (Sugar-water ratio 60%).*

Color — White to slightly creamy. Free from visible brown specks.

Flavor and Odor — Sweet, clean flavor. Free from objectionable odors.

Texture — Uniformly smooth, free from lumps, sandiness and sugar sediment.

Yeasts and Molds — Should be free from yeasts and molds. Yeasts and molds in excess of 10 per gram should disqualify for top grade.

Bacteria — Maximum limit of 50,000 per gram but should not be in excess of 10,000 per gram, as determined by the Standard Methods of the American Public Health Association.

Viscosity — Semi-fluid. Slow flowing and sufficiently viscous to hold lactose crystals in permanent suspension.

Sediment — Using a 225 gram sample and testing methods recommended by the American Bulk Condensed Milk Association, there should not be sediment in excess of that indicated on the No. 2 pad of the Standard which has been adopted by the American Bulk Condensed Milk Association.

Acidity — A solution of 9 grams of condensed milk and 18 grams of water should not show in excess of .55% acidity by the usual titration method used for the determination of the acidity of milk.

II. Sweetened Condensed Whole Milk

Milk Solids — Shall contain not less than 30% total milk solids of which not less than 8½% (Federal Standard) shall be milk fat.

Sugar (Sucrose) — Shall contain not less than 42% sugar. (Sugar-water ratio 60%).*

Color — Slightly creamy. Free from visible brown specks.

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*Sugar-water ratio $= \dfrac{\%\ \text{Sugar}}{100\%\ \text{Milk Solids}} \times 100$

Flavor and Odor — Sweet, clean flavor and no objectionable odor.

Texture — Uniformly smooth. Free from lumps, sandiness and fat separation.

Yeasts and molds — Should be free from yeasts and molds. Yeasts and molds in excess of 10 per gram should disqualify for top grade.

Bacteria — Maximum limit of 50,000 per gram but should not be in excess of 10,000 per gram, as determined by Standard Methods of the American Public Health Association.

Viscosity — Semi-fluid. Slow flowing and sufficiently viscous to hold lactose crystals in permanent suspension.

Sediment — Using a 225 gram sample and testing methods recommended by the American Bulk Condensed Milk Association, there should not be sediment in excess of that indicated on the No. 2 pad of the Standard which has been adopted by the American Bulk Condensed Milk Association.

Acidity — A solution of 9 grams of condensed milk and 18 grams of water should not show in excess of .40% acidity by the usual titration method used for the determination of the acidity of milk.

III. Plain Condensed Whole Milk

Milk Solids — Shall contain not less than 30% total milk solids of which not less than 7.9% (Federal Standard for Evaporated Milk) shall be milk fat.

Color — Slightly creamy. Free from visible brown specks.

Flavor and Odor — Sweet, clean flavor and no objectionable odor.

Texture — Uniformly smooth. Free from lumps and sandiness.

Yeasts and Molds — Should be free from yeasts and molds. Yeasts and molds in excess of 10 per gram should disqualify for top grade.

Bacteria — Maximum limit of 50,000 per gram but should not be in excess of 10,000 per gram, as determined by Standard Methods of the American Public Health Association.

Sediment — Using a 225 gram sample and testing methods recommended by the American Bulk Condensed Milk Association there should not be sediment in excess of that indicated on the No. 2 pad of the Standard which has been adopted by the American Bulk Condensed Milk Association.

Acidity — A solution of 9 grams of condensed milk and 18 grams of water should not show in excess of .40% acidity by the usual titration method used for the determination of the acidity of milk.

IV. Plain Condensed Skim Milk

Milk Solids — Shall contain not less than 30% milk solids.

Color — White to slightly creamy. Free from visible brown specks.

Flavor and Odor — Sweet, clean flavor and no objectionable odor.

Texture — Uniformly smooth, free from lumps and graininess.

Yeasts and Molds — Should be free from yeasts and molds. Yeasts and molds in excess of 10 per gram should disqualify for top grade.

Bacteria — Maximum limit of 50,000 per gram but should not be excess of 10,000 per gram, as determined by Standard Methods of the American. Public Health Association.

Sediment — Using a 225 gram sample and testing methods recommended by the American Bulk Condensed Milk Association there should not be sediment in excess of that indicated on the No. 2 pad of the Standard which has been adopted by the American Bulk Condensed Milk Association.

Acidity — A solution of 9 grams of condensed milk and 18 grams of water should not show in excess of .55% acidity by the usual titration method used for the determination of the acidity of milk.

V. Superheated Skim

Milk Solids — Not less than 30% milk solids.

Color — Creamy. Free from specks.

Flavor and Odor — Sweet, clean flavor and no objectionable odor. May have slight cooked flavor.

Texture — Uniformly smooth, free from lumps, sandiness and flakes.

Yeasts and Molds — Should be free from yeasts and molds. Yeasts and molds in excess of 10 per gram should disqualify for top grade.

Bacteria — Maximum limit of 50,000 per gram but should not be in excess of 10,000 per gram, as determined by Standard Methods of the American Public Health Association.

Sediment — Using a 225 gram sample and testing methods recommended by the American Bulk Condensed Milk Association there should not be sediment in excess of that indicated on the No. 2 pad of the Standard which has been adopted by the American Bulk Condensed Milk Association.

Acidity — A solution of 9 grams of condensed milk and 18 grams of water should not show in excess of .55% acidity by the usual titration method used for the determination of the acidity of milk.

Specials

This classification is provided to define **top quality** condensed milk manufactured to fill orders requiring a specific milk solid content less than 30%. From the standpoint of keeping quality the sugar-water ratio must not be less than 60%.

Bulk Plain Condensed Milk of **top quality** and varying from these approved standards only in a total milk solid content of less than 30% shall be classed as "Special."

Bulk Sweetened Condensed Milk, of **top quality** with a milk solid content of less than 30% and with a sugar-water ratio of not less than 60% shall be classed as "Special."

SELECTED BIBLIOGRAPHY FOR DAIRY INDUSTRY

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Index